MECHANICAL ENGINEERING

November 1957

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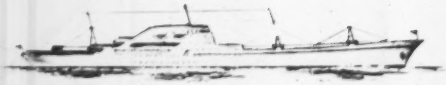
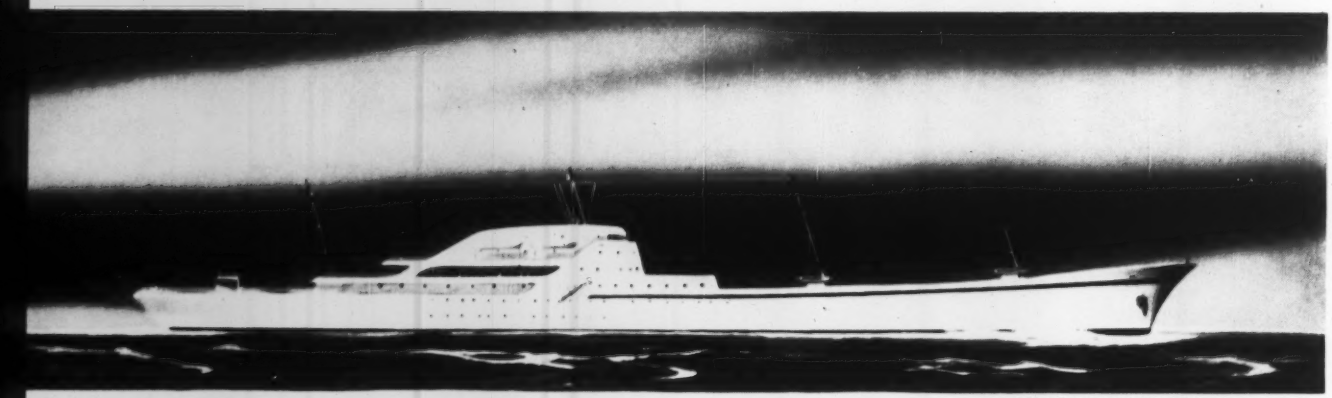


Leading the Way to a Nuclear-Powered Merchant Fleet



GEORGE G. SHARP, INC.

Scheduled to be ready for sailing by 1960, the first nuclear-powered merchant vessel will help to assess the economic feasibility of nuclear power as a means of propelling merchant ships . . . another big step toward putting the power of the atom to work constructively and economically. Designed to steam for 350,000 miles—about 3½ years—on a single loading of nuclear fuel, the single screw ship will have a capacity of 9,000 to 10,000 deadweight tons of cargo plus 60 passengers.

The Contract To Design, Manufacture and Install the complete pressurized water reactor propulsion system for this new vessel has been awarded to The Babcock & Wilcox Company. The advanced reactor, being developed at B&W's Atomic Energy Division at Lynchburg, Va. will utilize fuel elements of low uranium-235 enrichment. The complete propulsion system is being designed to develop a maximum of 22,000 shaft-hp.

In Nuclear Power Development, The Babcock & Wilcox Company comprises a single source for power reactors, propulsion reactors, research reactors, fuel elements, reactor components and experimental reactor development. The designing and engineering of complete nuclear steam generating plants are supported by B&W's long experience in related fields, helping to apply the most recent developments in engineering knowledge to the solution of your problems. The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.

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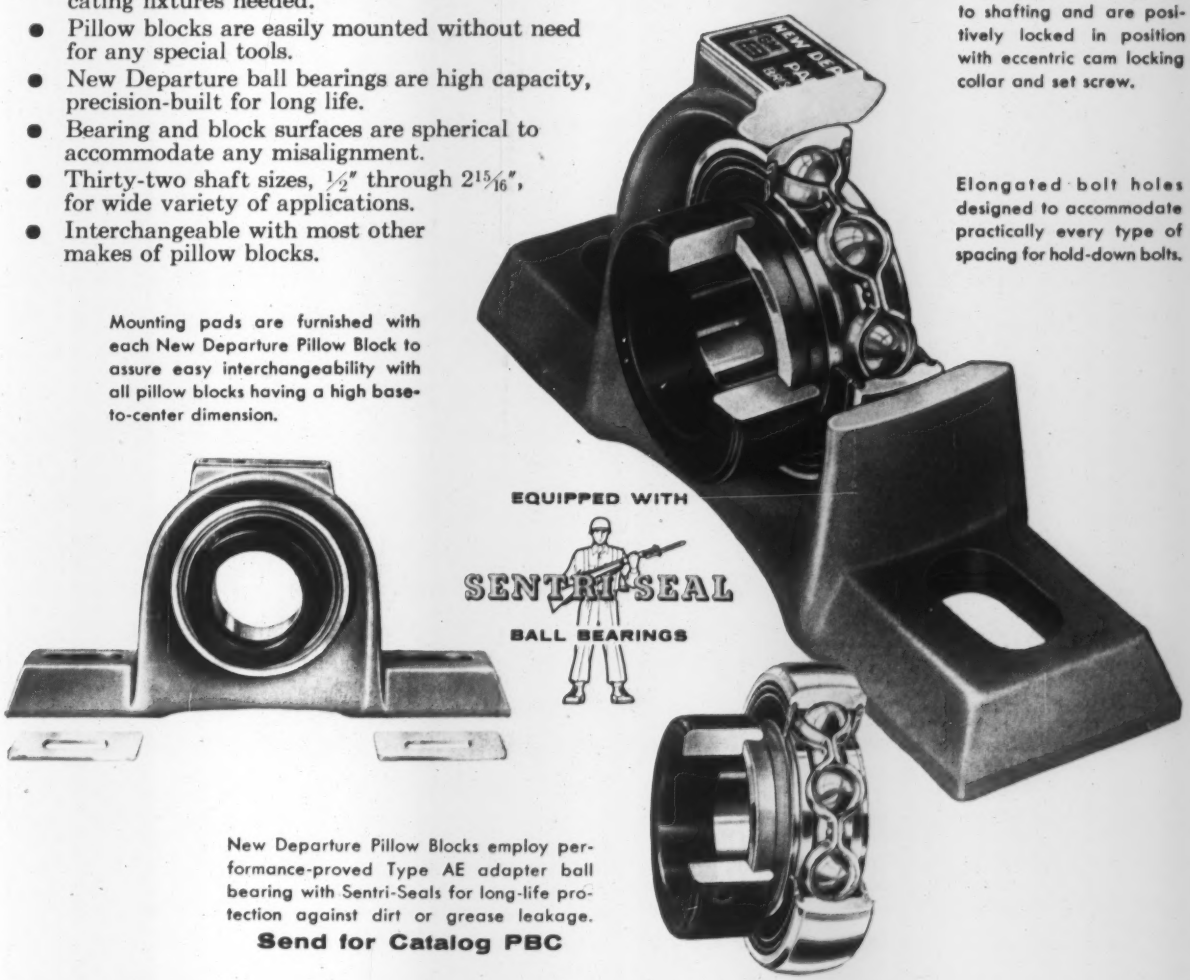

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NOTHING ROLLS LIKE A BALL

MECHANICAL ENGINEERING, November, 1957, Vol. 79, No. 11. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members $3.50 annually, single copy 50¢; to nonmembers $7.00 annually, single copy 75¢. Add $1.50 postage to all countries outside the United States, Canada, and the Pan-American Union. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

You get automatic foolproof lubrication with LUBRIVAL circulating oil system

FARVAL—
Studies in Centralized Lubrication
No. 207

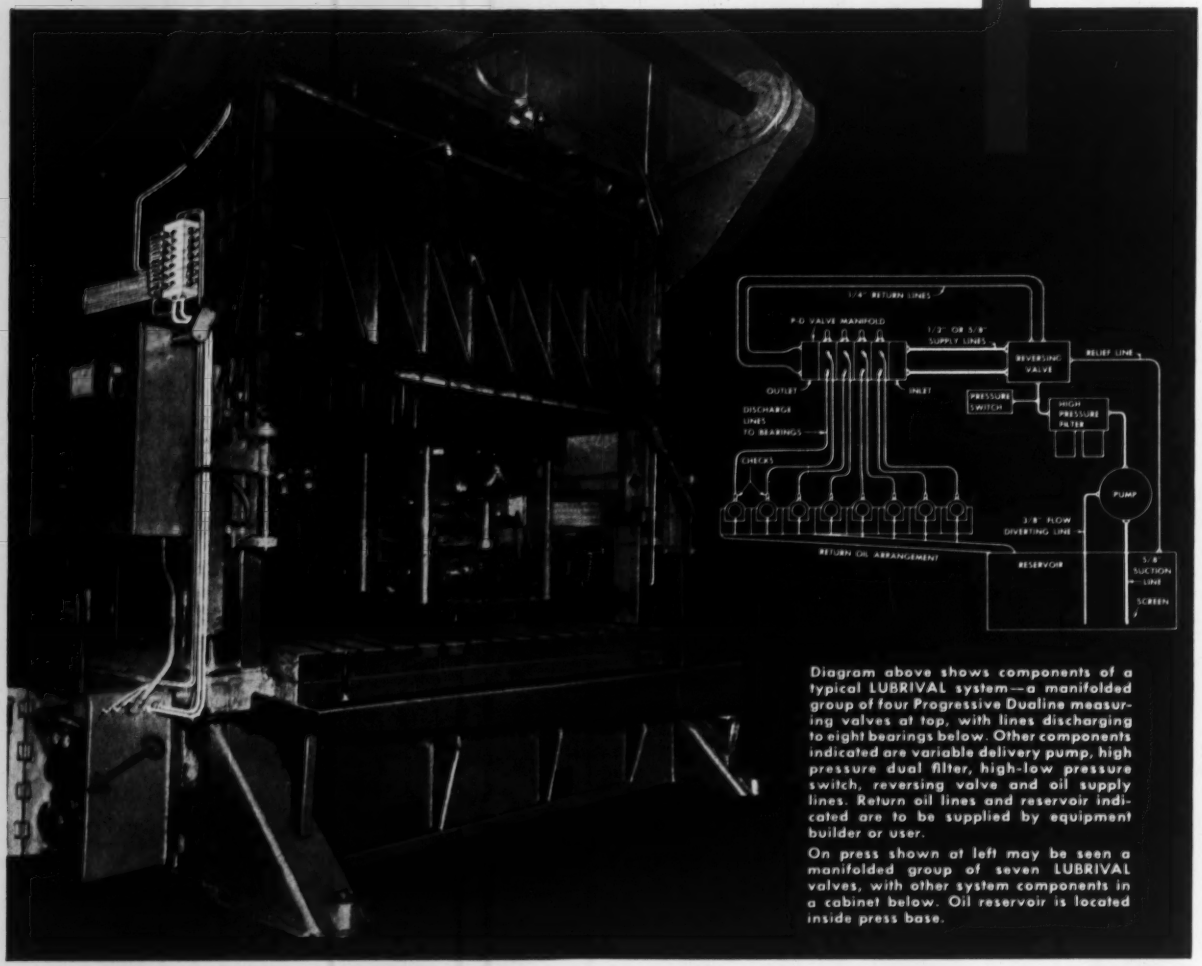

Diagram above shows components of a typical LUBRIVAL system—a manifolded group of four Progressive Dualine measuring valves at top, with lines discharging to eight bearings below. Other components indicated are variable delivery pump, high pressure dual filter, high-low pressure switch, reversing valve and oil supply lines. Return oil lines and reservoir indicated are to be supplied by equipment builder or user.

On press shown at left may be seen a manifolded group of seven LUBRIVAL valves, with other system components in a cabinet below. Oil reservoir is located inside press base.

●The bearings of this 150-ton metal stamping press and others of its type are now protected by LUBRIVAL. This new Farval system for circulating oil is being installed on many varied kinds of machine tools, presses, automated machines, and other equipment calling for circulating oil lubrication.

Employing the famous Dualine principle, LUBRIVAL delivers oil to manifolded measuring valves which feed it under pressure to the bearings. Lubricant is force-fed by positive piston displacement. Flow can be regulated over a range of 10 ounces to one gallon per minute. Valves have individual sight indicators and offer a degree of installation and operational flexibility previously unknown in such devices.

The Farval representative near you will give you all details. Or write for Bulletin 70. The Farval Corporation, 3264 East 80th Street, Cleveland 4, Ohio.

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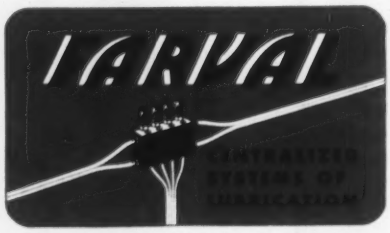
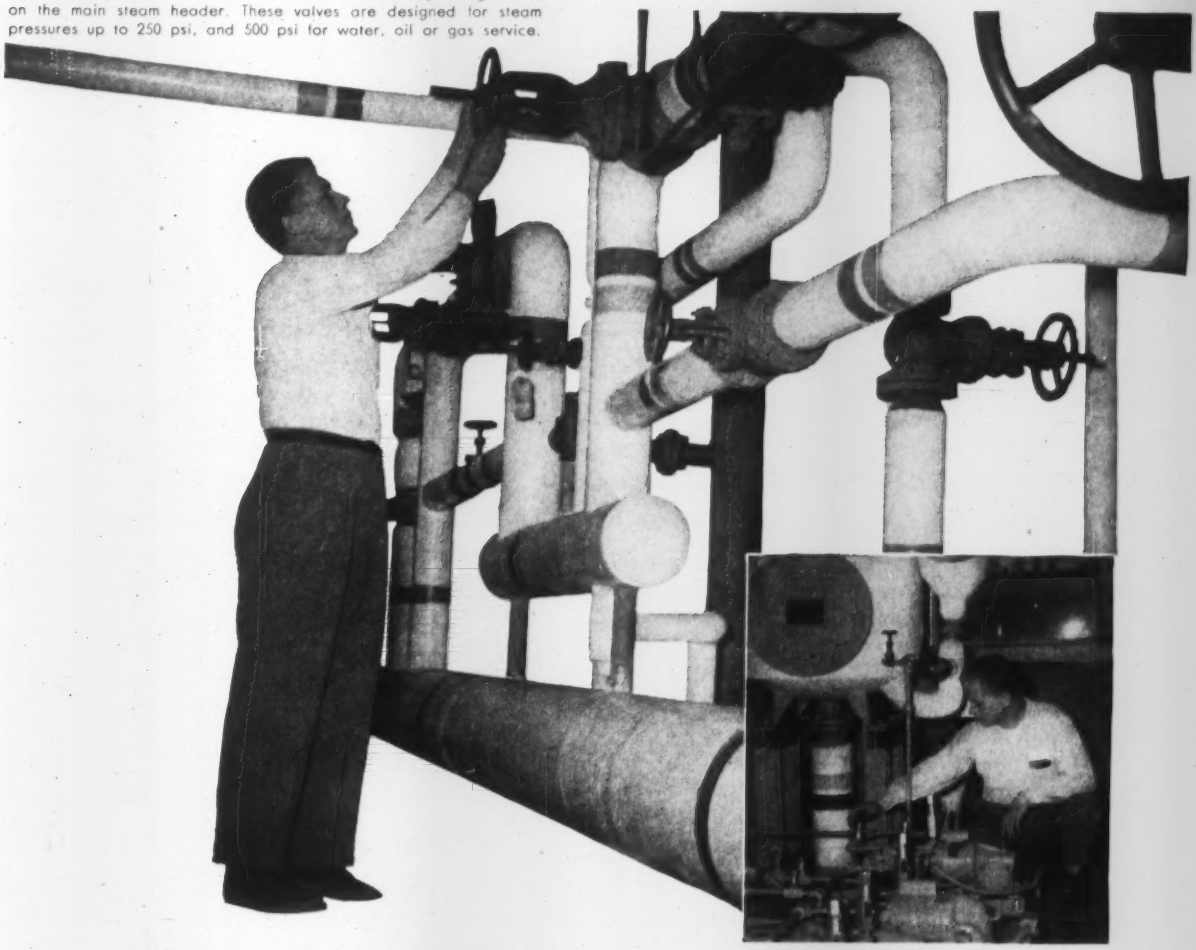


The Chief Engineer closes an 8-inch Walworth Iron Body Wedge Valve on the main steam header. These valves are designed for steam pressures up to 250 psi, and 500 psi for water, oil or gas service.



Chief Engineer Bruce W. Martin checks Walworth Bar Stock Valves in chemical feed pump lines to boiler and feed water. These carbon steel valves are built for ratings up to 3000 psi. Stainless steel bar stock valves are also available for very severe service.

"from big gates to little globes"...

The power plant at the Michigan School for the Deaf has an operating capacity of 25,000 lbs. per hour generated by three 200 hp and one 60 hp oil-fired boilers. Built four years ago, the plant is now the responsibility of Chief Engineer Bruce W. Martin who says: "This plant was designed and constructed for efficient operation, and a lot of that efficiency depends on the valves. From big gates to little globes installed here, we use a wide variety of Walworth Valves. They give us the dependable, trouble-free service we want and expect. I would recommend them to anybody for similar service."

Walworth's complete lines of valves are built to provide long range service and savings. There's a Walworth Valve in a type, size, and material to serve you . . . Gate, Globe, Angle, Check, and Lubricated Plug Valves in a variety of pressure ratings. The next time you need valves or have a problem concerning flow control, call your Walworth Distributor, or, write Walworth direct.

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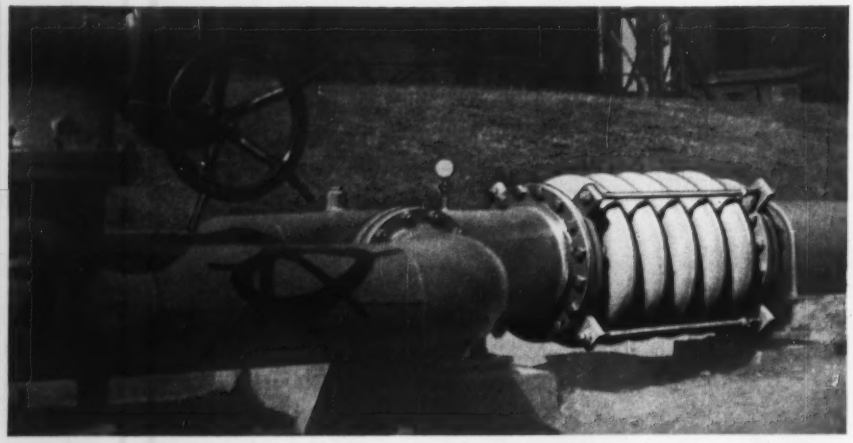
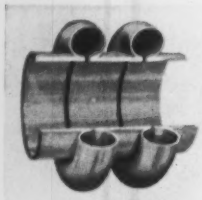
This expansion joint has been in continuous, trouble-free service since 1946!



Far from unusual, the record for this hydraulically formed Marquette OMEGA corrugated expansion joint installed at an eastern utility is typical. There have been no functional failures of OMEGA joints since they were first put into service several years prior to the illustration shown above. Unlike more conventional catalogued joints, OMEGA joints are sold only after a review of the application by the MARQUETTE PIPING DESIGN DIVISION (see card in Consulting Service columns of this publication). If expansion is better handled by other methods, such advice is provided.



Differing from other forms of toroidal expansion joints, corrugations for OMEGA joints are hydraulically formed by *five* individual stages within contour-controlling progress dies. This procedure results in uniform thickness throughout the entire corrugation, and physical uniformity of all corrugations. It also permits mathematically accurate predictions of magnitude and location of pressure and deflection stresses. The final configuration is one of uniform, constantly varying radii (geometric progression), inducing a smooth stress pattern under all conditions; with the stresses remarkably low, as experimental analysis has repeatedly proven. This is in sharp contrast to other toroidal joints which show erratic and non-uniform stress patterns within each corrugation.

Government-conducted comparative cyclage tests show that Marquette OMEGA joints outlast all other types, including other toroidal forms. This is true, for equal deflections, even when compared to longer joints having more corrugations. It is safe to state that more research and technical reports have been undertaken on OMEGA joints than all other types combined.

OMEGA joints were originally designed by stress-conscious Marquette piping analysts for use on installations where expansions could not be absorbed by the flexibility factors commonly employed. Their proven dependability has been dramatic, permitting their use where joints would hitherto never have been considered. However, Marquette believes that successful expansion joint installations are based 65% upon correct piping design with the balance of credit resting on the quality of the joint. Since the aberrant OMEGA joint possesses singular characteristics, not found in any other joints, the Marquette Piping Design Division has devised many new means of taking optimum advantage of OMEGA joint assets. OMEGA joints, operating at predictable stress levels, can be designed to serve in maximum stress Code piping systems and function within the elastic limit of the bellows material.

The manufacturing division of Marquette also designs and builds the more conventional (MAR-FLEX) type of joints, which have been marketed since 1890, for applications specified by the client. However, where dependability is of prime concern, OMEGA joints are the only ones which can be, with honesty, recommended.

The primary Marquette service, pipe system designing, has been employed for many years by leading utilities, manufacturers and process industries. The primary product, Marquette OMEGA Expansion Joints, has been specified with increasing frequency by consulting engineers throughout the world. No claims are made for better facilities—just better know-how. However, no limit in size and service conditions has yet been encountered.

The opportunity to discuss your problems is respectfully solicited, and your inquiries addressed to the Manufacturing and/or Piping Design Division are assured of prompt attention.

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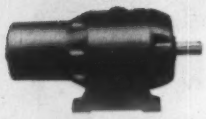
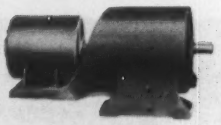
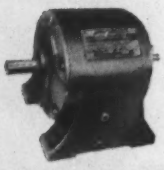


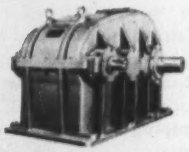
Integral Gearmotor



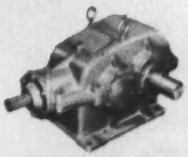
All Motor Gearmotor



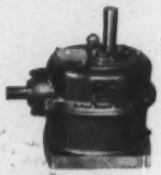
StraitLine Reducer Double Reduction Type RD



Parallel Shaft Reducer



Right Angle Speed Reducer



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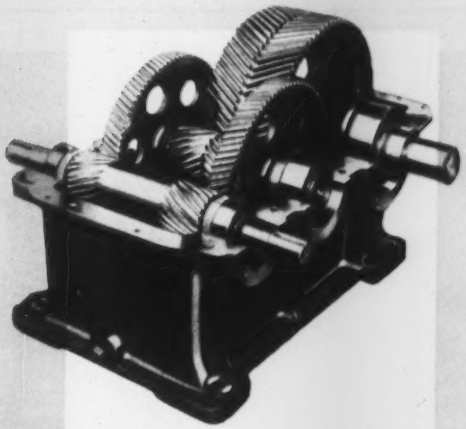

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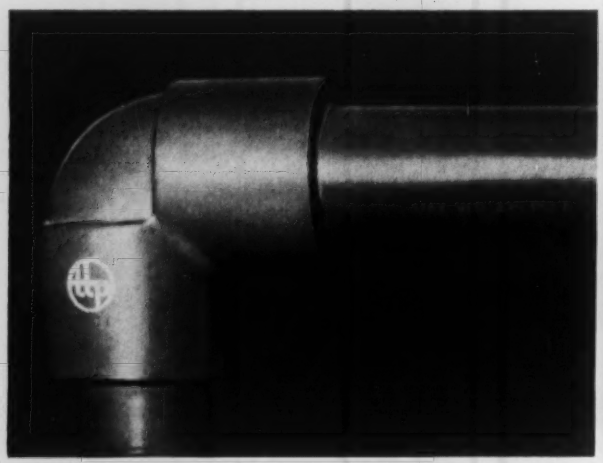

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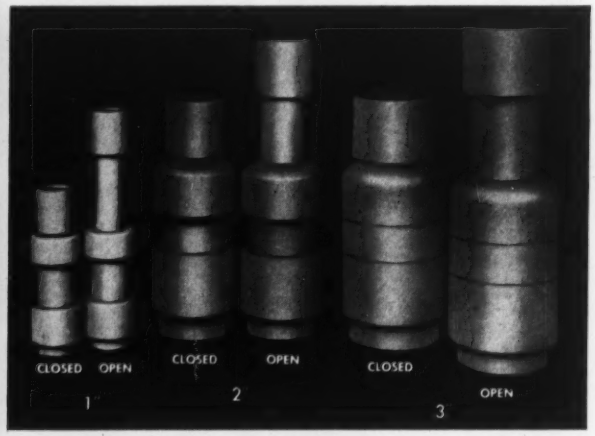

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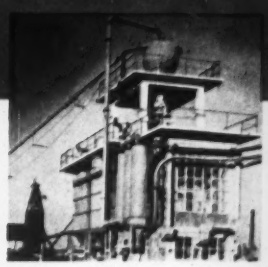

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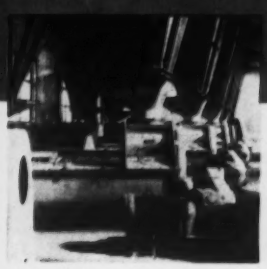

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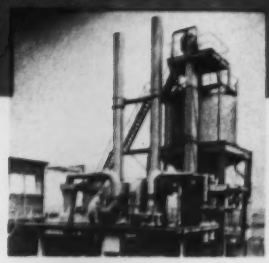

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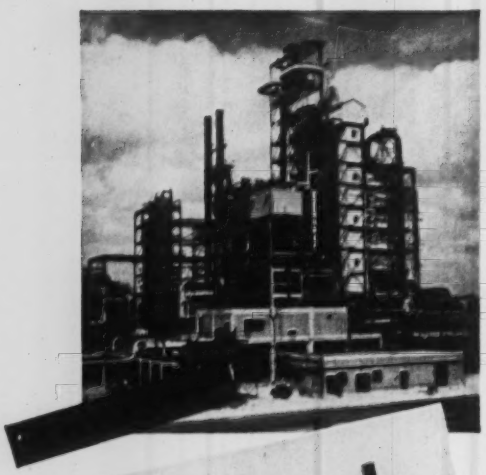

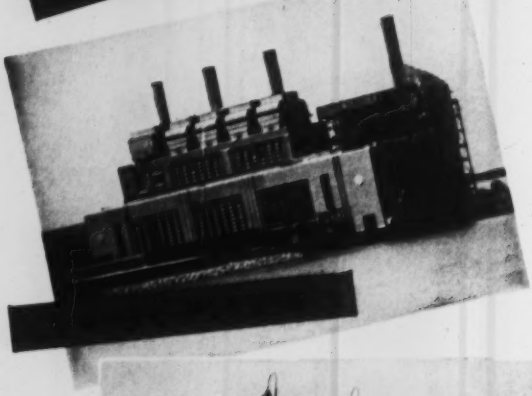

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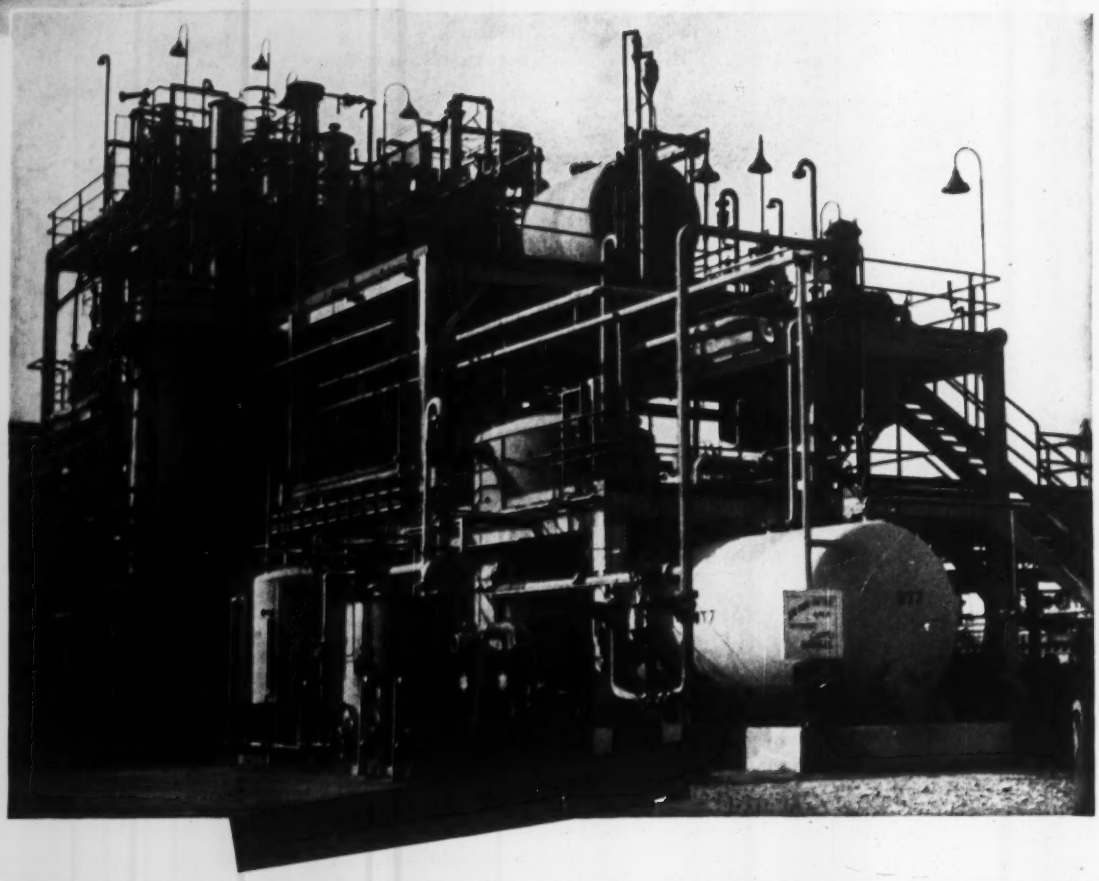

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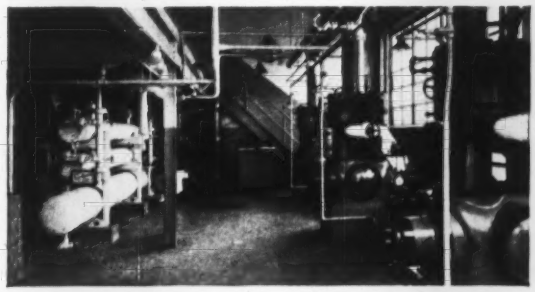
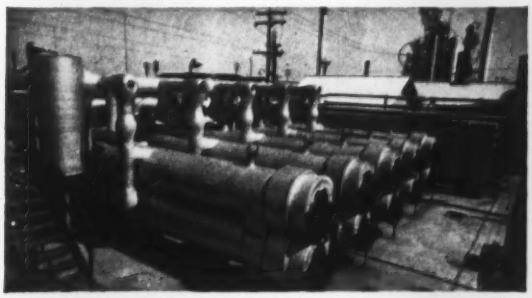


REFRIGERATION AND ICE MAKING EQUIPMENT

Widely employed in industry for important process work. Compression refrigeration systems, also Tube-Ice units, are available in a wide range of capacities.

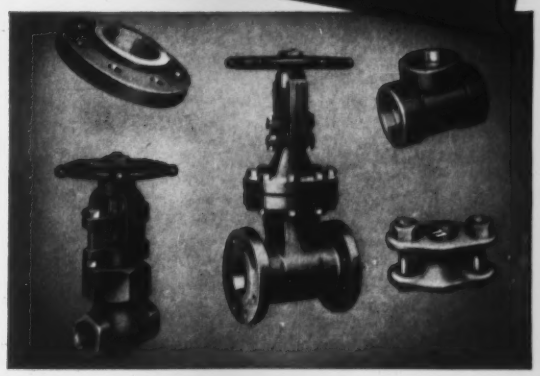


PROCESS EQUIPMENT FOR EVERY SERVICE

Constructed in wide variety to meet all Code requirements. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, high octane gasoline, synthetic rubber, chemicals and related products.

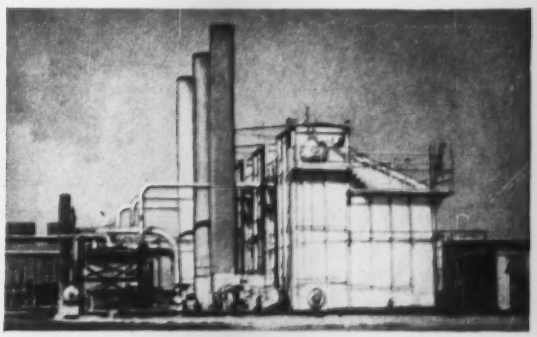
SPECIAL CORROSION RESISTANT MATERIALS

Vogt produces a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Corrosion resistant properties of welds match that of the materials used to construct the equipment.



DROP FORGED VALVES, FITTINGS AND FLANGES

Vogt valves, fittings and flanges are drop forged from carbon and alloy steels to safely handle liquids and gases at high pressures, and high temperatures. Complete line includes: flanged, screwed and socket weld end globe, gate and check valves. Also ells, tees and crosses—couplings—bushings—plugs—unions—flanges and flange unions, and welding heads.

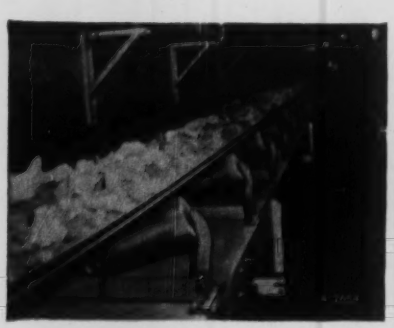


MODERN STEAM GENERATORS

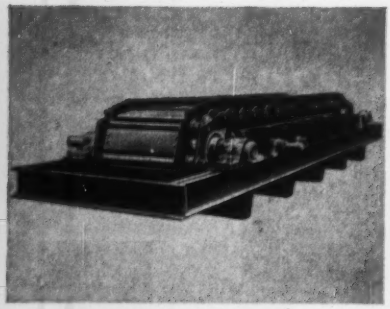
Custom built and package type Vogt steam generators give maximum rating in a minimum of space with high efficiency and low maintenance costs. Available in bent tube and straight tube designs for solid, liquid or gaseous fuels, burned singly or in combination to meet every power, processing or heating requirement.

STEPHENS-

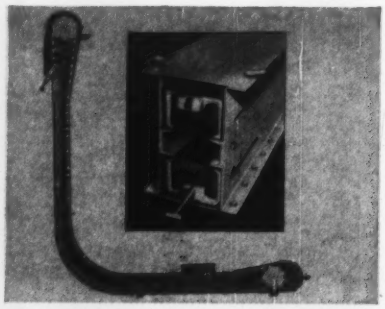
for the best conveying equipment–



BELT CONVEYORS

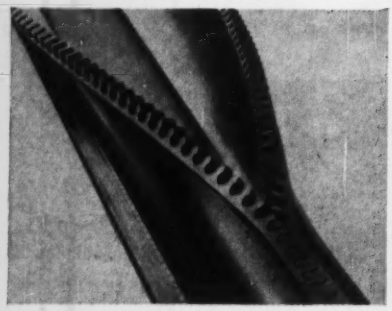


PAN CONVEYORS



REDLER CONVEYOR-ELEVATORS

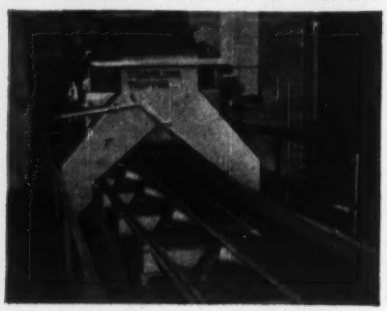
BUCKET ELEVATORS



ZIPPER CONVEYOR-ELEVATORS

MANGANESE STEEL PAN FEEDERS

LIVE ROLL GRIZZLIES



BELT CONVEYOR TRIPPERS

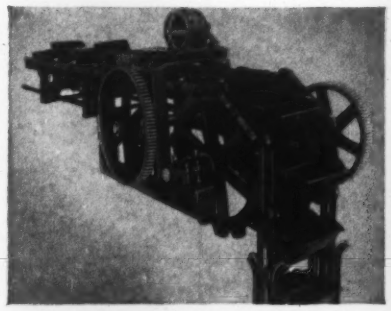
Where dry bulk materials must be conveyed and processed—anywhere in the world—STEPHENS-ADAMSON can supply the equipment to move them better, faster, and at lowest cost per ton. In every industry where bulk materials handling is part of the processing job, S-A engineers have the experience that accrues from planning thousands of installations.

If you need a single item, or a completely engineered and installed system, STEPHENS-ADAMSON has the exact conveyor machine, or will design the handling system that will do the job best. Our engineers will work independently or with plant engineers, consulting firms, and construction contractors.

Call on S-A. When you do, you call on 56 years of experience.

-ADAMSON

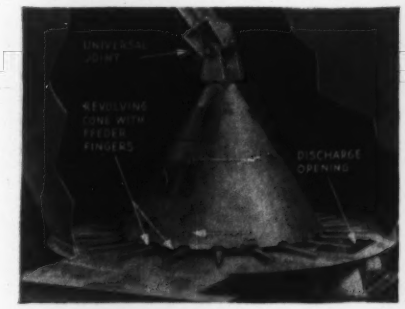
by the men who know conveying best!



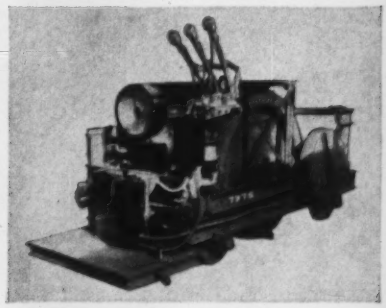
PIVOTED BUCKET CONVEYORS

PLATFORM CONVEYORS

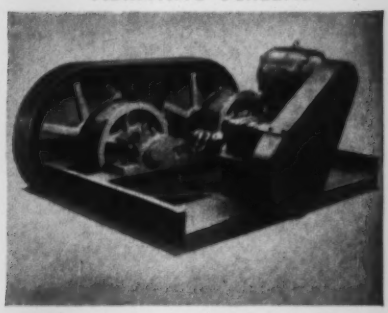
VIBRATING SCREENS



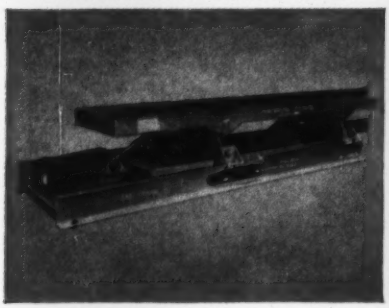
CIRCULAR BIN DISCHARGERS



BATCH CARS

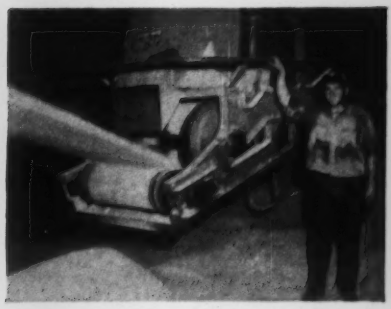


CONTINUOUS CAR PULLERS



FREQUENCY CONVEYORS

KNITTEL CRUSHERS



TRIMMERS

The line of products shown in these pages are only indicative of the tremendously broad range of the STEPHENS-ADAMSON line of conveying and processing equipment. There are bulletins available on all items shown. Your S-A district engineer will gladly provide layouts and recommendations for a completely engineered system.

STEPHENS-ADAMSON MFG. CO.

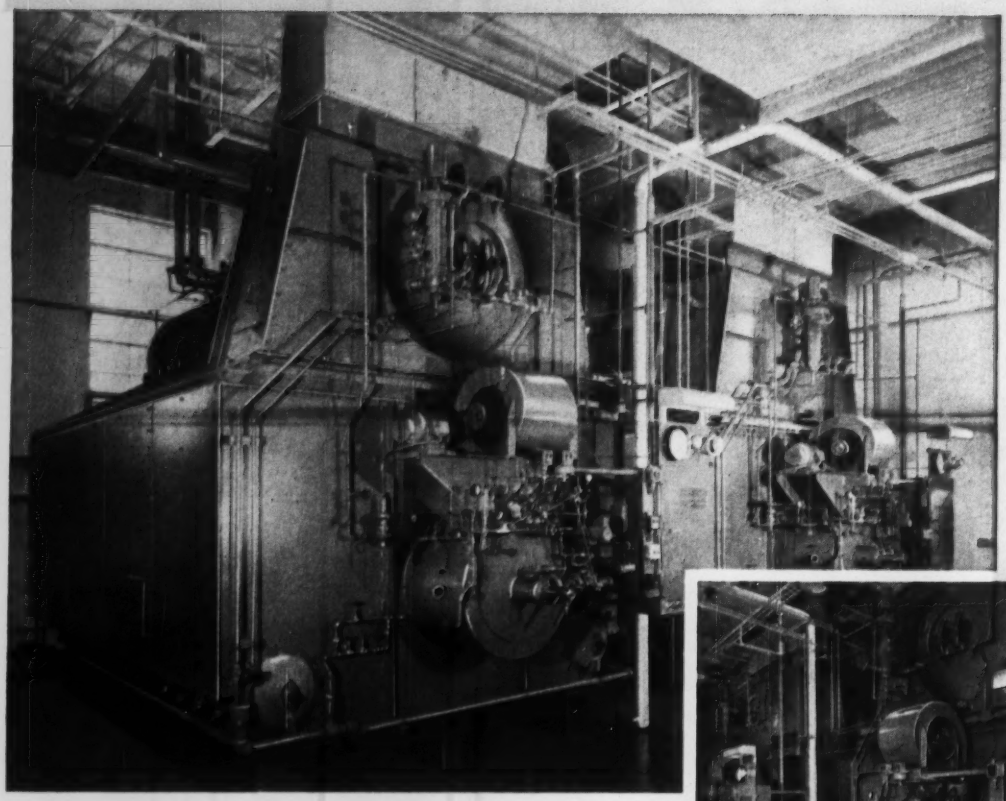
19 RIDGEWAY AVENUE, AURORA, ILLINOIS
LOS ANGELES, CALIFORNIA
BELLEVILLE, ONTARIO

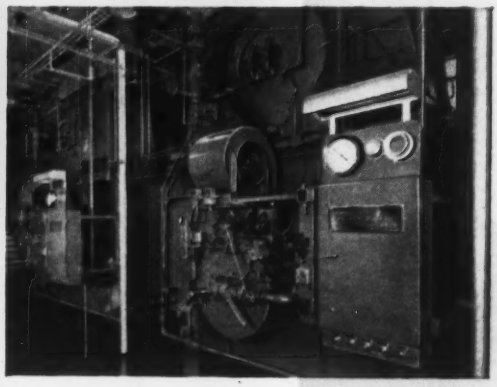
IT PAYS TO CONVEY THE S-A WAY

FOR UNFAILING, ECONOMICAL SERVICE,

WICKES Type A, shop-assembled

specified for the Edward W. Sparrow

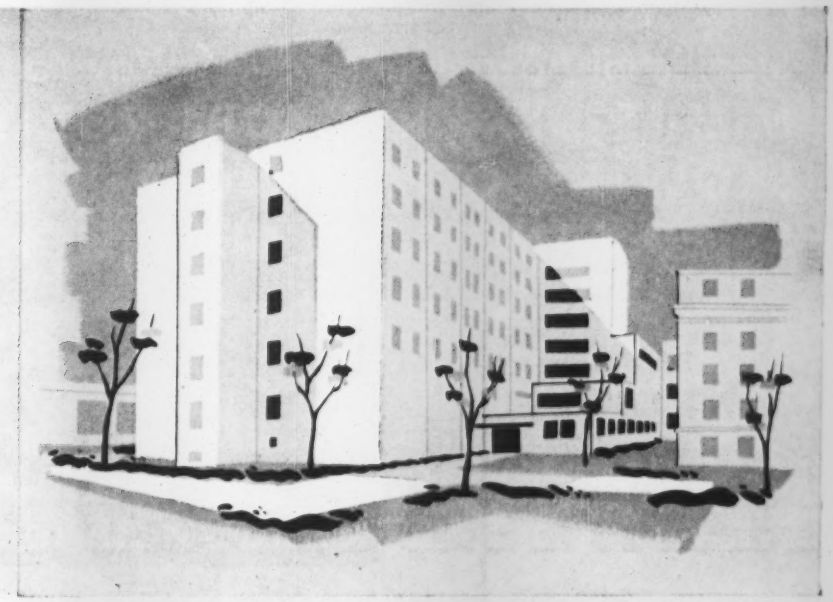




Wickes Type-A Steam Generators combine custom engineering and shop-assembly to give you economical "packaged power" to exactly meet the load requirement. The entire unit is shipped complete ready to set on your foundation and installation can be made with minimum interruption of your production schedules. All necessary auxiliary equipment including trimmings, soot blowers, feed water regulators and other accessories, are shop-installed leaving field installation at a minimum. From the pressure-tight casing to the oil-gas burner, Wickes type-A water tube steam generators with capacities up to 60,000 lbs. of steam per hour are designed and engineered to be the standard of quality and performance in a variety of industries.

boilers are

hospital



Architects sketch of new Sparrow Hospital.
Architects: O. J. Munson Associates–Lansing, Michigan.
Professional Engineers: E. Roger Hewitt Associates, Inc.–Lansing, Michigan.

One of the most important considerations in hospital construction specifications is the steam generation system, because it must give around-the-clock reliability without failure. It is significant, then, that for the Edward W. Sparrow Hospital in Lansing, Michigan, two Wickes shop-assembled Type-A Steam Generators have been installed to provide a dependable source of heat. The new units, which are housed, in a completely new boiler house, replace the original Wickes coal fired boilers. Each of these two new boilers are capable of producing 18,500 lbs. of steam per hour at an operating pressure of 125 psi. They provide 2250 square feet of heating surface and are equipped with fully automatic Wickes combination oil and gas burners. These units have a design pressure of 160 psi.

Write for our Catalog 56-1 for detailed information on Wickes Type-A Boilers, and we will also include our Bulletin 55-1 covering the complete line of Wickes Products and Facilities.

WICKES

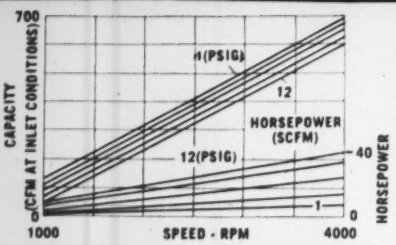
DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • ***SALES OFFICES:*** Albuquerque, N.M. • Boston • Buffalo • Charlotte, N.C. • Chicago Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D.C.

Significant Advantages... Every Way You Compare Them!

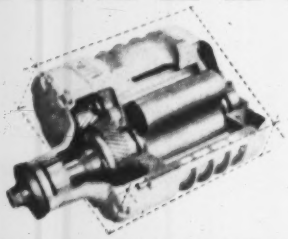
MIEHLE-DEXTER 3-LOBE ROTARY POSITIVE BLOWERS OFFER WIDER PRESSURE AND SPEED RANGE, LESS CUBE, LIGHTER WEIGHT

Pressure Range From 1 to 12 psig; Speed Range From 1000 to 4000 rpm



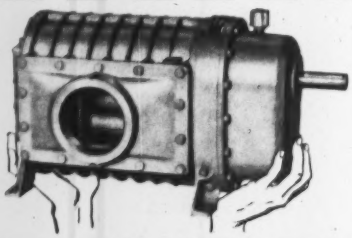
M-D Blowers operate at wider pressure and speed ranges than other rotary positive blowers. The capacity of a typical M-D Blower (Model 4012 with a 4" rotor 12" long) at various pressures and speeds is shown at the left. The capacities of eleven other production models range from 50 to 4000 cfm.

Smallest Cube Dimension of All Rotary Positive Blowers



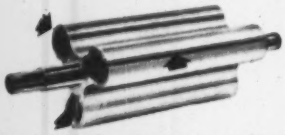
Less space is required for M-D Blowers than any other rotary positive blower because of the exclusive 3-lobe rotor design. This means M-D Blowers can be integrated into existing systems without requiring major space reallocations. The space-saving advantage of M-D Blowers for original installations is obvious.

Lightest Weight With Aluminum Rotors and Housing



M-D Blowers weigh considerably less because of aluminum rotors and housings, standard for most models. This construction not only simplifies installation but provides greater structural strength. The 3-lobe rotor design provides the capacity you require in smaller space with lighter weight.

Exclusive Formica Wear Strips On Rotors; Rubber Grid On End Plate

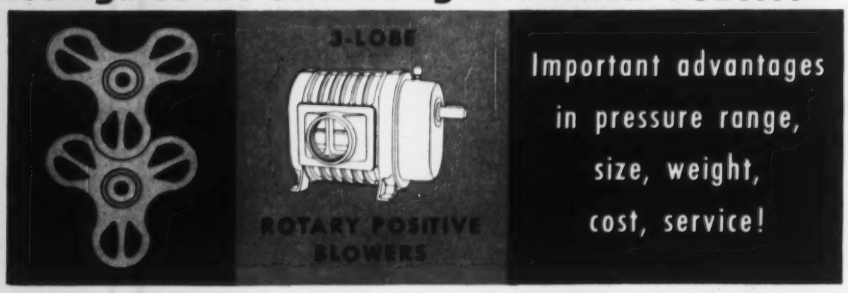


Exclusive formica wear strips on each rotor lobe reduce clearance between rotor lobes and housing to practically zero.

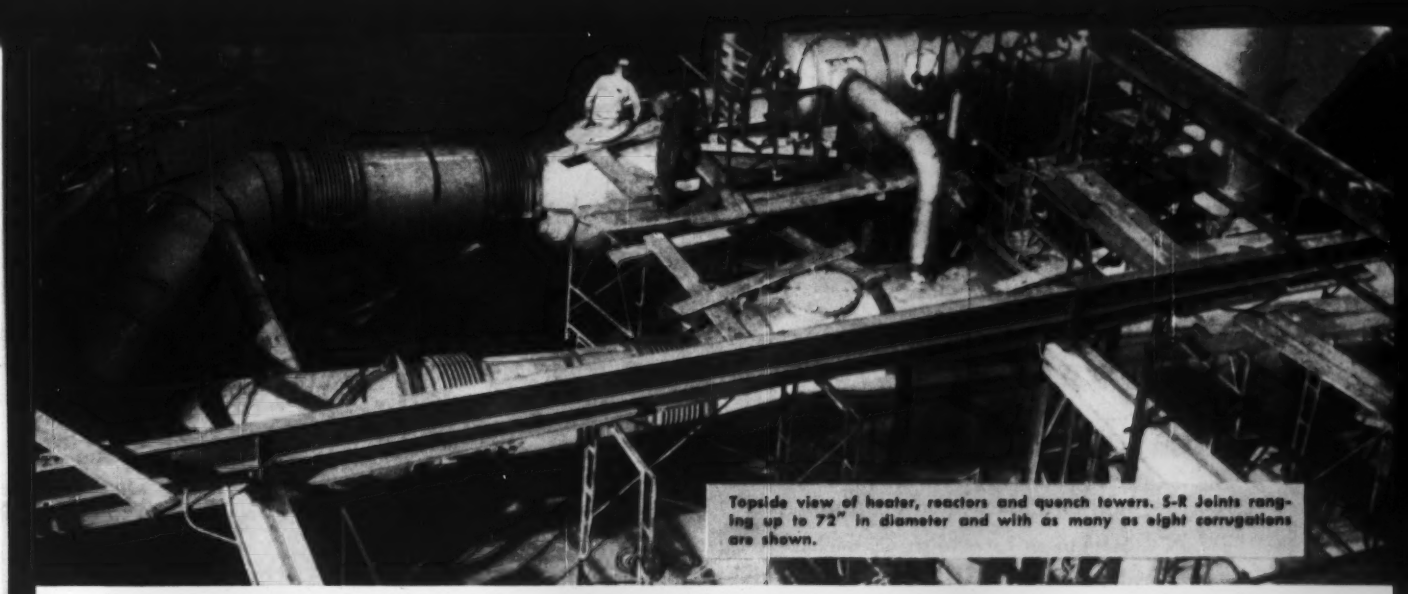
The patented synthetic rubber grid, vulcanized to the metal end plate by a special process, eliminates metal-to-metal contact between the rotor and the end plate — assures longer rotor life and efficient operation.

➔ *The performance figures are convincing . . . WRITE TODAY!*

miehle dexter



MIEHLE-DEXTER DIVISION, RACINE, WIS. • TELEPHONE MELROSE 4-5521 • Another Product of MIEHLE-GOSS-DEXTER, Incorporated



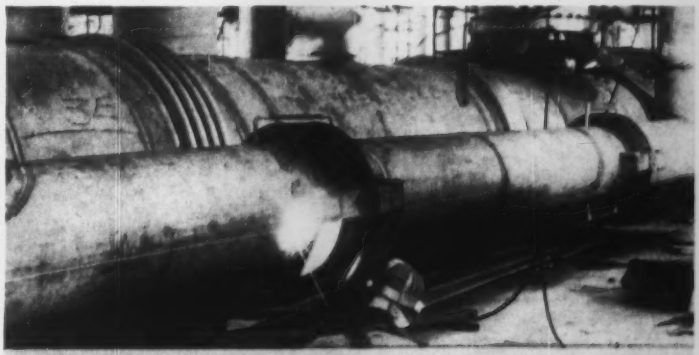
Topside view of heater, reactors and quench towers. S-R Joints ranging up to 72" in diameter and with as many as eight corrugations are shown.

188 Badger Expansion Joints Protect Equipment in Texas Butadiene's New Plant

At the time Texas Butadiene's new plant was designed, engineers figured that the high temperatures required by the process would cause excessive pipe expansion — and possible damage to equipment. They solved this critical operating problem by specifying Badger S-R Expansion Joints — *to absorb and control pipe movement.*

Now — with a total of 188 Badger Expansion Joints in operation (ranging in size from 14" to 72") — Texas Butadiene's new plant at Lyondell, Texas is making processing history. Designed to solve just such exacting expansion problems, the Curvilinear Corrugations and tubular Reinforcing Rings of S-R Expansion Joints insure better equalization and longer cyclic life (see diagrams below).

Size for size, new Badger S-R Joints weigh up to 50% less than conventional types . . . and their new ring design reduces joint diameter. A complete line of accessories — including covers and liners — is available. *Write today for fully illustrated brochure.*



Large line (air in — air out — product out) under reactors includes twelve S-R 48" stainless steel joints to handle temperatures of 1150° F. at 35 psig. Small evacuation line uses fourteen 16-inch S-R Joints.

Close up of Regeneration Air Line. This line has fourteen 48" stainless steel S-R Joints handling temperatures over 1000° F.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced . . . life increased.

Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer joint life.

Series 150 corrugation and ring cross-section

BADGER

S R

SERVICE RATED

EXPANSION JOINTS

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BADGER MANUFACTURING COMPANY
230 Bent Street, Cambridge 41, Mass. • 60 East 42nd Street, New York, New York
Representatives in Principal Cities

MULTIPRESS

boosts carbon core production 33%

at CLEVELAND GRAPHITE BRONZE

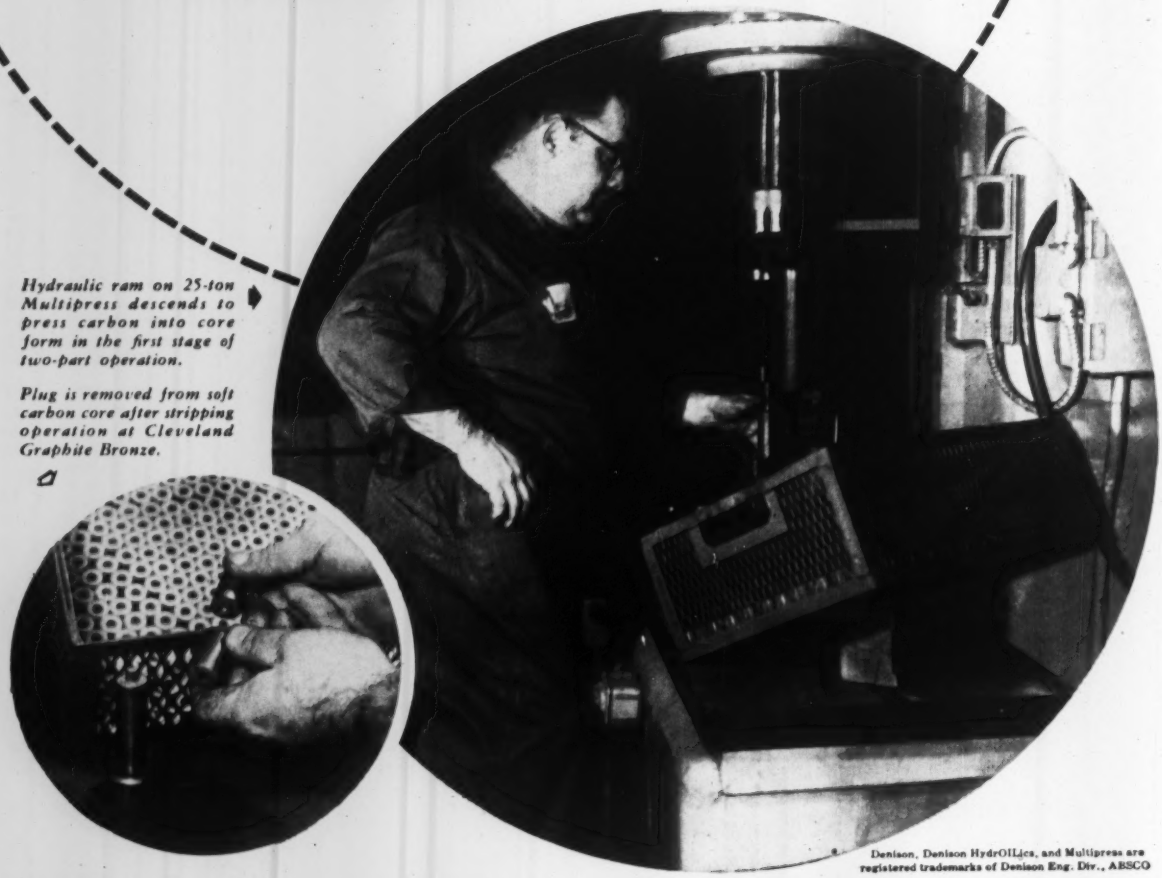
Cleveland Graphite Bronze has increased the production of soft carbon cores for aircraft bearing castings by 33% using a 25-ton Denison hydraulic Multipress.

Machining cores to shape, the best alternative method, can be done at the rate of 70-75 per hour. With Multipress, 100 cores are formed in the same period. Soft carbon at one-tenth the cost can be used instead of the hard carbon required in a machining operation.

Datalog COM-3 describes this operation in detail.
For your copy, write Denison Engineering Division, American Brake Shoe Co., 1174 Dublin Road, Columbus 16, Ohio.

DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS
MOTORS • CONTROLS



Hydraulic ram on 25-ton Multipress descends to press carbon into core form in the first stage of two-part operation.

Plug is removed from soft carbon core after stripping operation at Cleveland Graphite Bronze.

Denison, Denison HydrOILics, and Multipress are registered trademarks of Denison Eng. Div., ABSCO

Surface defect led to closer examination
Laminated area curled back
Dark line shows extent of lamination
CUTAWAY SECTION
SIDE VIEW of 6" x 4", Schedule 40, "Question Mark" welding reducer, cut out of line.

Watch out for the after-costs of Question Mark fittings!

Unknown fittings may look like a bargain on the price tag, but watch out for the consequences!

Surface defects led to the above "Question Mark" fitting being cut from the piping. Further examination showed the steel inside was laminated. Pieces cut out literally fell apart. Here was an open invitation to serious trouble . . . lost production, wasted dollars and possible human casualties.

This is another example of a dangerous situation posed by unknown fittings of questionable quality . . . a serious threat to the safety and economy of well-engineered piping.

You can avoid these risks by specifying KNOWN fittings!

DANGER! *Your first warning of Question Mark fittings is their lack of complete, permanent identification of manufacturer, wall thickness, weight, material . . . as required by A.S.A. code.*

A message in the interests of top quality piping
. . . by Tube Turns, Louisville, Kentucky

YOUR SAFEGUARD

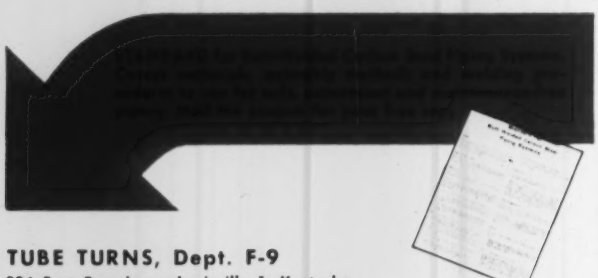
Safeguard your piping investment with known fittings!

TOP QUALITY! *Directional and size changes in this process piping are made with TUBE-TURN Welding Elbows and Reducers . . . recognized for their unsurpassed uniformity and quality.*

The cost of fittings is a small fraction of the total cost of a piping system. To buy "cheap" fittings and run the risk of impairing the performance of your entire system can, therefore, be "penny wise and pound foolish."

When you specify and buy TUBE-TURN* products, you know your investment is safeguarded by unsurpassed quality of fittings and flanges. They meet all American Standard and Safety Code requirements. Each product is permanently marked with complete size and material designation.

COMPLETE LINE! *Your nearby Tube Turns' Distributor gives you prompt delivery from the complete line of more than 12,000 Tube Turns' stocked items. Photo courtesy The Ross-Willoughby Co., Columbus, Ohio.*



TUBE TURNS, Dept. F-9
224 East Broadway, Louisville 1, Kentucky

Please send new Standard for Butt-Welded Carbon Steel Piping Systems.

Company Name _____

Company Address _____

City _____ *Zone* *State*

Your Name _____

Position _____

Available from your nearby TUBE TURNS' distributor

*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

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A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

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MILLIONS OF SHARP, SUPERHEATED PARTICLES, traveling at high velocities, quickly wear dust collector linings, mains, downcomers, etc. Metals and most ceramics simply can't withstand this harsh abrasion. But CARBOFRAX refractories can—even at temperatures as high as 2500°F. A CARBOFRAX dust collector lining in an ore sintering machine is, for example, still in use after 10 years' service.

Refractories ... to resist abrasion

Exceptional resistance to abrasion—whether caused by tiny gas-borne particles or sliding steel billets—is one of the most useful properties of several of Carborundum's unique refractory materials. For example, when used in the exhaust lines of gasoline catalytic cracking units in temperatures ranging up to 1200°F, these refractories lasted 3 years, as compared to alloy rings which lasted for 6 months.

And when abrasion is combined with higher temperature, the exceptional resistance of these super refractories becomes even more apparent and useful. As skid rails in furnaces which heat 6-lb. billets to 2250°F—pushing 250 slugs an hour—CARBOFRAX® silicon carbide refractories need one-third the replacement, one-third the labor and one-third the down-time of ordinary rammed chrome ore hearths. Other successful applications include: dust collectors, gas scrubbers, transfer pipe lines, hydro cyclones and process equipment parts, to name but a few.

Many applications call for other properties in combination with wear resistance. Among Carborundum's many materials are refractories that also offer excellent heat shock resistance with sufficient hot strength to withstand 25 psi at 3128°F. Others provide unique resistance to corrosion as well as abrasion. These properties are but a few of those to be found in super refractories pioneered by Carborundum. Among them, you are almost certain to find answers to your refractory and high-temperature problems. For help, fill in and mail this coupon:

CARBORUNDUM
Registered Trade Mark

----------MAIL THIS COUPON TODAY----------

Dept. 1117, Refractories Division,
The Carborundum Company, Perth Amboy, N. J.

Please send me:

- ☐ Forthcoming issue of Refractories Magazine
- ☐ Bulletin on Properties of Carborundum's Super Refractories
- ☐ Here is a description of my high temperature problem. Can you help me?

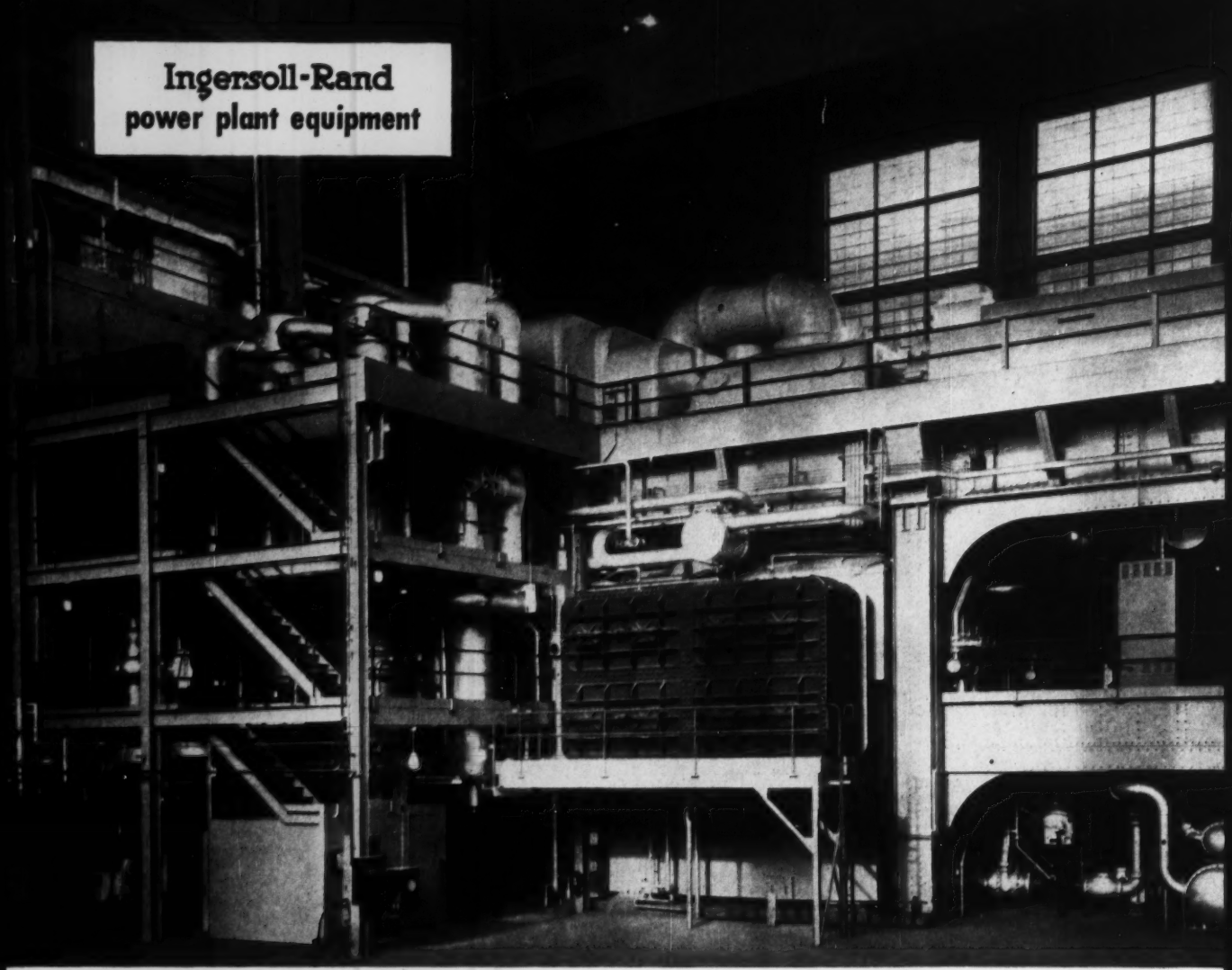
Name _____ Title _____

Company _____

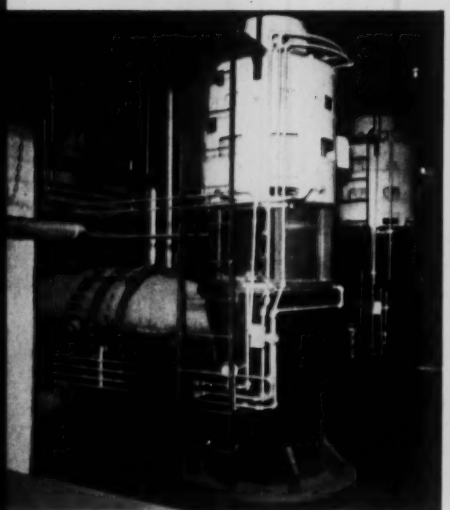
Street _____

City _____ Zone _____ State _____

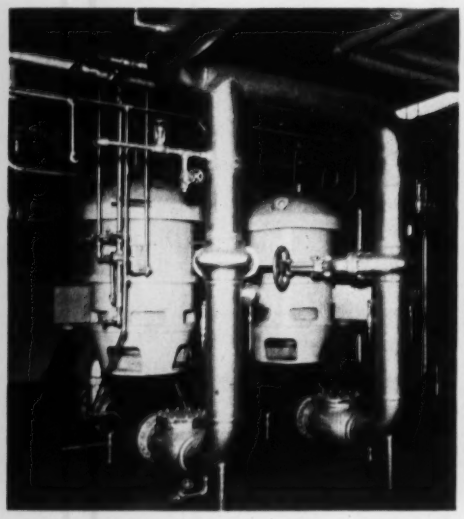
Ingersoll-Rand
power plant equipment



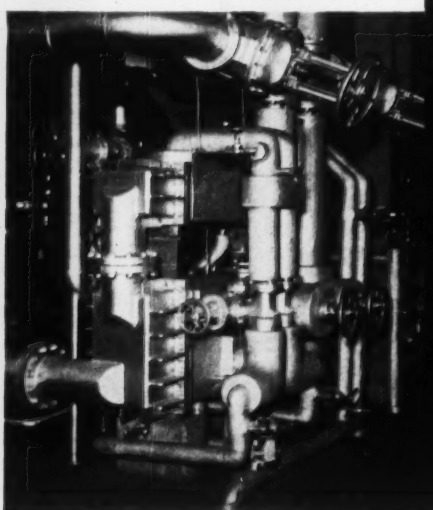
CONDENSER. Space-saving Ingersoll-Rand rectangular condenser, with 75,000 sq ft of cooling surface, serves the bottom-exhaust steam turbine for the 100,000-kw generating unit at this large, modern steam plant.



CIRCULATING PUMPS. Two Ingersoll-Rand Class APM vertical circulating pumps, each with capacity of 32,500 gpm, handle the condenser cooling water.



CONDENSATE PUMPS. The condenser is also served by two Ingersoll-Rand Class APHC vertical hot-well pumps, each handling 1400 gpm of condensate.



STEAM-JET EJECTOR. This Ingersoll-Rand two-stage steam-jet ejector is used to evacuate the condenser of all air and non-condensible gases.

How Another Central Station Profits with

MATCHED PERFORMANCE

of POWER-PLANT EQUIPMENT

by **Ingersoll-Rand**

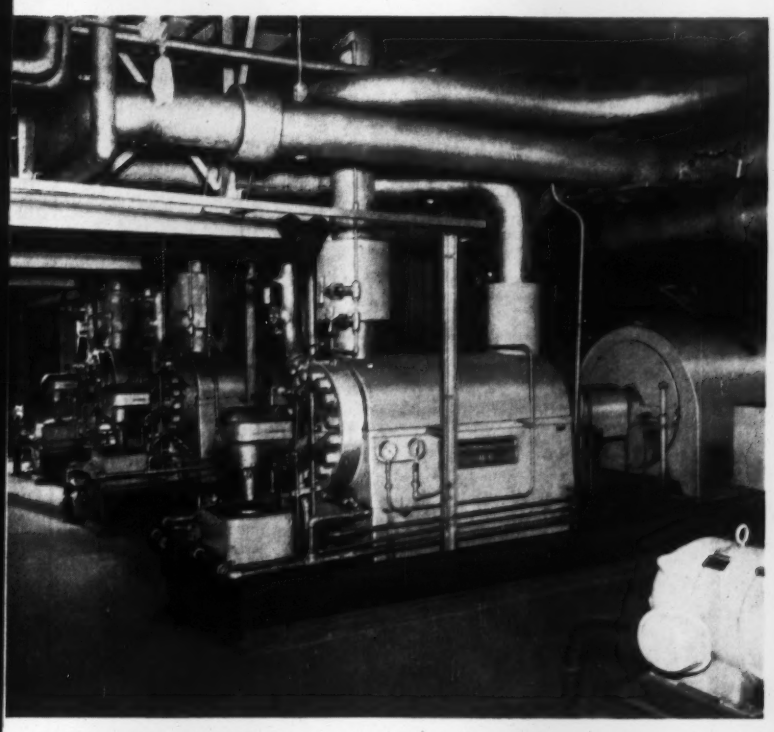
All of the Ingersoll-Rand equipment shown here is installed in a single large utility steam plant.

The condenser, circulating pumps, condensate pumps, ejectors and boiler-feed pumps are designed and built for matched performance — matched to each other and to the job. Functional coordination of these elements is vital to the economy and continuity of the steam generating cycle. And by entrusting the undivided responsibility for their design and construction to I-R power plant equipment specialists, the user is assured of maximum efficiency and dependability in continuous, heavy-duty service.

The compressed air equipment, too — for soot blowing and instrument air — plays an important role. Although basically unrelated to each other, these compressors are matched to the job — designed to give top performance and economy under actual plant conditions.

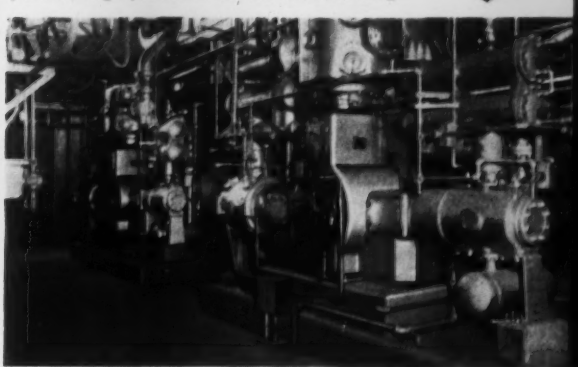
Whatever your power plant requirements — for condensers, pumps, vacuum equipment and compressors — be sure to contact your Ingersoll-Rand representative. His specialized experience in product and application engineering can save you time, effort and expense in meeting your exact requirements to best advantage. Ingersoll-Rand, 11 Broadway, New York 4, N. Y.

14-679

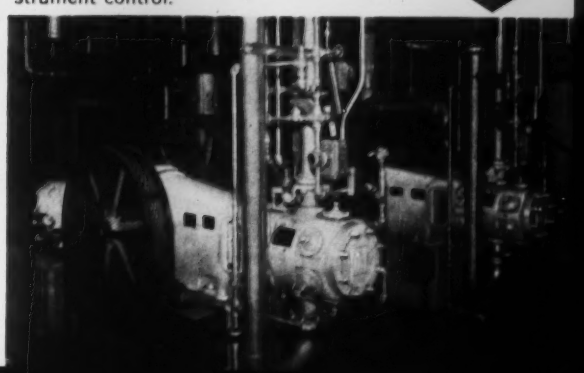


BOILER-FEED PUMPS. Three Ingersoll-Rand Class CHTA boiler-feed pumps, with double-case construction and "unit-type" rotor assembly, each handle 990 gpm at 2300 psi discharge pressure.

SOOT BLOWING COMPRESSORS. Two I-R three-stage TVH compressors with direct-connected motor drive provide high-pressure air for soot-blowing.

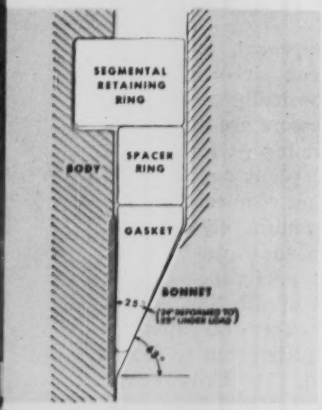


INSTRUMENT AIR. Two I-R ES-NL compressors with non-lubricated cylinders provide oil-free air for instrument control.



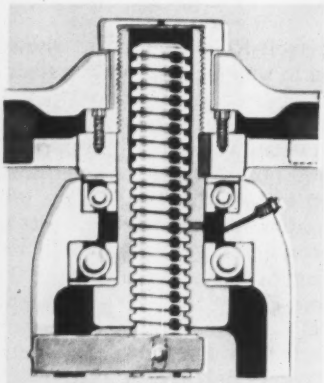
How To Get SPECIAL Features

Tips on selection, installation and operation of steel



NON-LEAK PRESSURE-SEAL BONNET JOINT

By changing bonnet-gasket angle from 45 degrees to shape shown, sealing area is increased 300%, sealing force doubled. Soft iron gasket is electroplated with a lead alloy which flows under pressure, assures tight seal. No sharp gasket edge to damage. Easily disassembled.

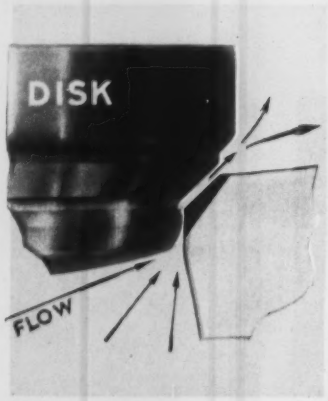


EVALTHRUST* BALL-BEARING CONSTRUCTION

This patented ball-bearing construction is found in all large, high-pressure Edward Valves. Double races on the yoke stem reduce operating torque . . . effectively transmit highest closing torques. An Edward "exclusive."

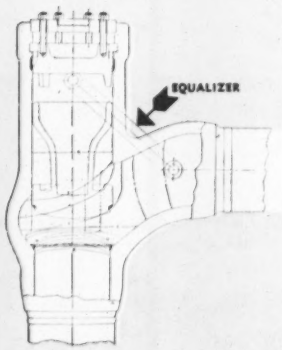
LEAK-PROOF INTEGRAL SEAT

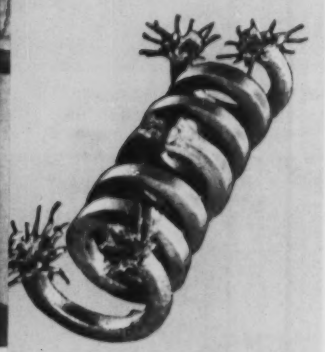
Integral Stellite seat in Edward Valves cuts maintenance, prevents leakage between seat and body. For perfect alignment, applied Stellite is precision-machined in same set-up as body bore, then carefully lapped to form drop-tight mated seating surfaces.



ORIGINAL-DESIGN EDWARD EQUALIZER

For check and non-return valves, the Edward Equalizer connects the high-pressure area above disk-piston with the high-velocity, low-pressure area in the valve outlet. Increases disk lift, cuts pressure drop, reduces disk vibration.





EVALPAK* PREMIUM VALVE PACKING

Edward developed the *first* asbestos-graphite packing with special processing to prevent stem pitting. Die-molded to fit exactly the stem and stuffing box, it is wire-supported and features low operating torque. Durable, easily replaceable.

IMPACTOR* HANDWHEEL

Exclusive Impactor* handwheel multiplies the closing force a man can deliver, assures tight seating with minimum effort in minimum space. Often eliminates need for bulky, expensive gearing or motors.

*Reg. T.M., Edward Valves, Inc.

Rockwell-Built Edward Valves

in STANDARD Steel Valves

valves from Edward, long-time leader in the field

We all know that no one gets "something for nothing." Yet, by careful evaluation and selection, it *is* possible to obtain "special" features in *standard* steel valves. The secret lies in buying "by company" as well as by price. In dealing with Edward, whose products have been the industry's standard of excellence for years, you avail yourself of three important benefits:

1. access to the results of continuing laboratory research on steel valves;

2. expert assistance on valve selection, installation, operation, maintenance and repair;

3. steel valves which are truly superior in design, function and durability . . . but which are not substantially more expensive than ordinary types.

For example . . . a half-dozen "special valve" features —which are *standard* in Edward Valves—are shown in handy clip-out form on the opposite page. ALL of these features are Edward "firsts" . . . MOST are Edward "exclusives" . . . EACH means *extra value* for you!

We invite you to consult your Edward Valve Representative. He is technically trained, thoroughly experienced, eager to help you obtain the *most* value for your valve dollar. At his disposal—and yours—are the results of substantial investment in steel valve research. Let him *use* those results to solve your problems. A card or a call will bring him "on the double" . . . so make it a point to contact us *now!*

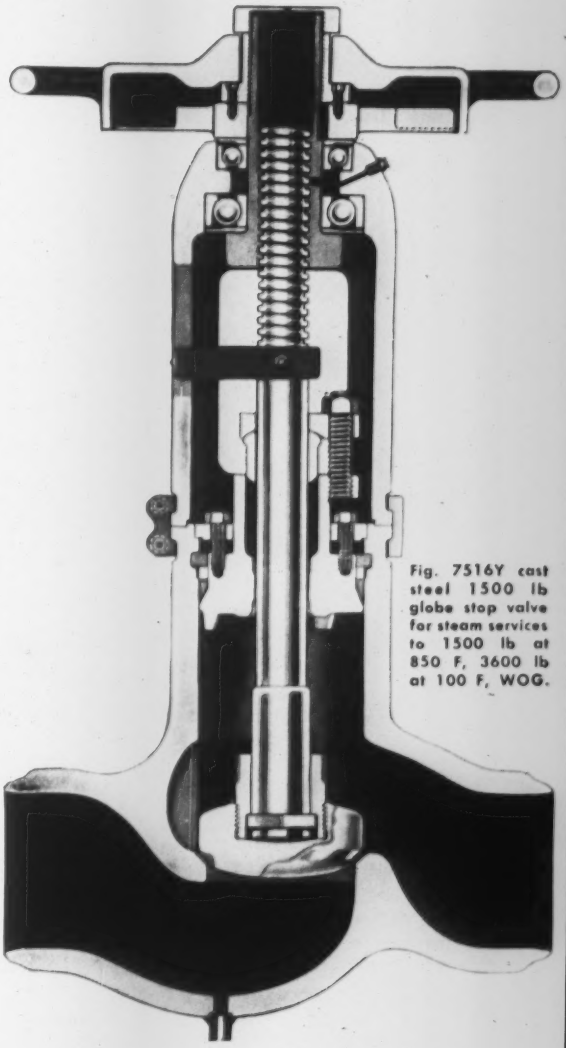


Fig. 7516Y cast steel 1500 lb globe stop valve for steam services to 1500 lb at 850 F, 3600 lb at 100 F, WOG.

Edward builds a complete line of forged and cast steel valves from ⅛" to 16" in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs for pressures up to 7500 lb with pressure-seal, bolted, union or welded bonnets and screwed, welding, or flanged ends.

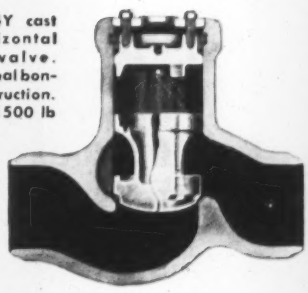


Fig. 7594Y cast steel horizontal check valve. Pressure-seal bonnet construction. Rated at 1500 lb at 850 F.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1228 West 145th Street, EAST CHICAGO, INDIANA

Here's why Wrought Iron Pipe serves longer at lower cost-per-year

Wrought iron pipe's longer life comes from its unique composition and structure. It is a two-component metal . . . high purity iron and glasslike iron silicate. The iron silicate is distributed throughout the iron in the form of threads or fibers. There are more than 250,000 fibers per sectional square inch.

These same fibers, illustrated in the magnified section above, give wrought iron its built-in protection against corrosion. When corrosion attacks, the network of these defensive fibers quickly arrests pitting and rapid penetration. As a result, corrosion is forced to spread out over the entire surface instead of penetrating the pipe wall, as happens in other materials. This effective safeguard against corrosion means that wrought iron pipe lasts longer at lower cost-per-year.

Service records in a variety of installations support this longer-life reputation of wrought iron pipe. Some of the applications where wrought iron is serving and saving are: heating system piping; air conditioning and refrigeration piping; water supply piping; sanitary system piping; sewage plant services; electrical conduit.

More of this story, and why you can use wrought iron pipe with confidence, is told in our booklet, *The ABC's of Wrought Iron*. Write for your copy today.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N.Y.

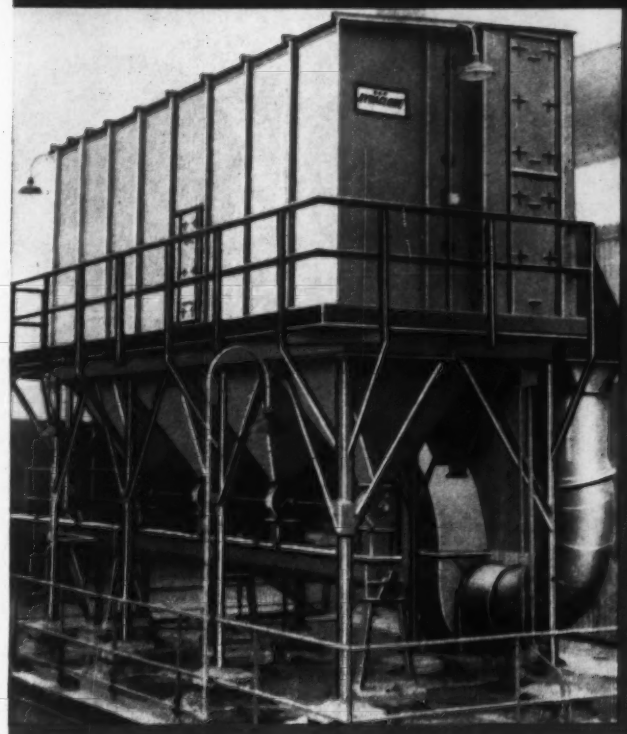
Available in Canada and throughout the world.

BYERS Wrought Iron Tubular and Hot Rolled Products

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS

Corrosion costs you more than Wrought Iron

Now . . . a New High in Dust Filter Efficiency . . .



New SLY "ROLL-CLEAN" Dynaclone

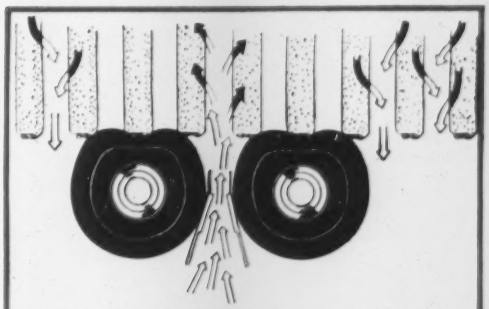
THESE NEW FIELD-PROVEN FEATURES

- Easier filter bag changing.
- Greater cloth area.
- Fewer operating parts.
- Free-rolling cleaner — no sliding.
- Complete dust seal — automatic seal adjustment.
- Easy access to all dust filter parts for inspection and servicing.

PLUS THESE TIME-TESTED DYNACLONE ADVANTAGES

- Constant suction at dust sources — complete dust collection.
- Self-cleaning for continuous operation.
- No auxiliary motors or blowers required for filter-bag cleaning.
- Greater filtering capacity and smaller space requirements — more cloth per cubic foot of filter than any other make.
- Lower power requirements.

The original self-cleaning dust filter, the Dynaclone has proven itself the most efficient dust filter ever made. The "Roll-Clean" Dynaclone combines design simplicity and rugged construction to insure even greater operating efficiency . . . even longer trouble-free service.



NEW "ROLLER CLEANER" provides greatly simplified method of cleaning dust from filter bags. Resilient rubber rolls automatically adjust to form a positive dust seal as each row of bags is cleaned by atmospheric air.

NEW CATALOG

. . . gives full details on "Roll-Clean" Dynaclone and other Sly Dust Filters . . . contains valuable engineering information. Write for your copy.

See it in Space 73, the Chemical Show, New York Coliseum, Dec. 2-6.

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THE W. W. SLY MANUFACTURING CO.

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A blue chip pump...

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CALIFORNIA ELECTRIC POWER COMPANY
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COLUMBUS & SOUTHERN OHIO ELECTRIC COMPANY
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COMMONWEALTH EDISON COMPANY
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CONNECTICUT LIGHT & POWER COMPANY
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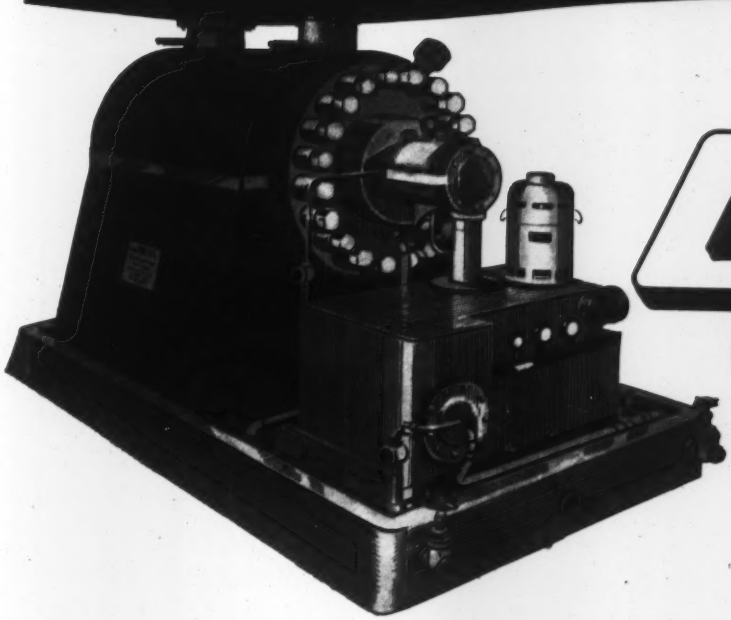
PACIFIC Boiler Feed Pumps



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ONE OF THE DRESSER INDUSTRIES

Write For Bulletin 122

PACIFIC PUMPS INC.

HUNTINGTON PARK, CALIFORNIA

Offices in all principal cities

BF-27

from cold strip to finished tubing IN SECONDS! with a YODER ELECTRIC-WELD TUBE MILL

One of the fastest . . . and one of the least expensive . . . methods of making steel tubing is with a Yoder Electric-Weld Tube Mill. The Yoder method eliminates the need for time-consuming heat treatments and costly conditioning furnaces for most tube needs. Scrap losses, too, are far lower than any other method . . . usually less than 2%.

The Yoder Type-M Mill shown above is operated by one man and a helper. Coiled strip on this mill is continuously cold-roll formed, welded and cut to required lengths in a matter of seconds . . . at speeds up to 340 f.p.m. The quality of the resulting tube is *constantly* better than the requirements of commercial standards. This is one of many reasons why manufacturers and users of tubing the world over are using more Yoder mills than all other makes combined.

If your business requires pipe and tubing, ferrous or non-ferrous, in sizes from ¼-inch to 26-inch diameter, Yoder can supply the engineering service and machines to produce it faster and better for less! For complete details, write for the Yoder Tube Mill Manual. It's yours for the asking.

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PIPE AND TUBE MILLS (ferrous or non-ferrous)
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NOW... PROVE YOUR BEST IDEAS—IN LESS TIME

The only desk-side electronic computer with direct programming and automatic positioning of decimal point

These exclusive features are just two of the many time- and money-saving advantages of the new IBM 610 Auto-Point Computer—a compact, low-cost, general-purpose electronic computer with many logical and arithmetic facilities to make engineering time more completely creative.

For example, the IBM 610 features single-instruction square root, simultaneous division and multiplication, highly flexible tape units, and requires only a minimum of instruction to learn to operate the machine. The 610 has been designed with reliability as a prime consideration—built-in self-checking provides assurance of accurate results.

Quickly, conveniently, and economically—the new 610 Auto-Point Computer helps you solve a wide variety of engineering and scientific problems. And this mobile desk-side computer does not require air conditioning—another cost-saving advantage. For complete details, simply call your local IBM representative.

A few applications of the 610 Auto-Point Computer

Cam Design
•
Vibratory Analysis
•
Stress and Strain Calculations

IBM TIME EQUIPMENT

TIME EQUIPMENT · DATA PROCESSING · ELECTRIC TYPEWRITERS · MILITARY PRODUCTS

Hot Creosote No Problem for Crane Stop-Check Valve

Defies splinters, dirt and grit

Handling hot creosote seems like an unusual application for stop-check valves. And it is!

But this installation points up dramatic proof of Crane quality—and what it means to cost-free operation.

For ten years the Long-Bell Division of the International Paper Company, at Longview, Wash., has had this Crane angle stop-check valve on a hot creosote line from a retort. The valve is operated every 24 hours. Occasionally solids come through—wood splinters, slivers, dirt and grit—and yet this Crane No. 30E 250-pound valve has a trouble-free record clear of any maintenance costs.

Why take chances with your valves—the heart of your flow control system. Be sure: specify Crane valves and fittings from the big, complete, strictly quality Crane line—industry's first choice for over a century.

YOU'LL WANT a copy of "Valve Performance Facts"—32 case histories covering valve installations throughout industry. Contact your local Crane Representative or write Crane Co. at address below.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

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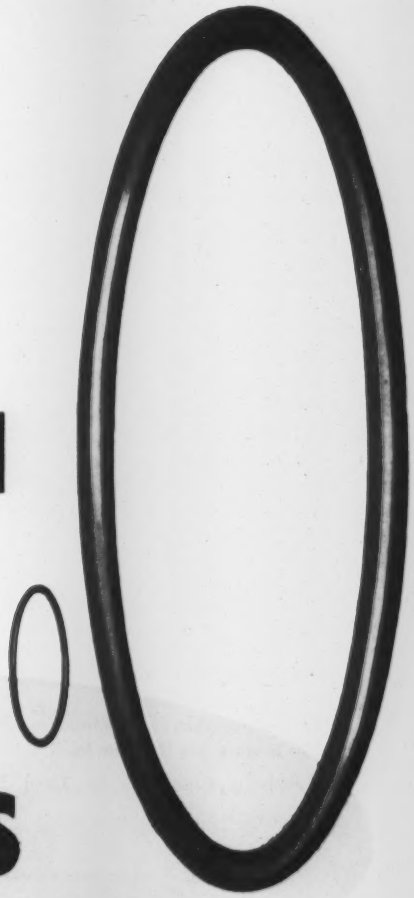
LOW COMPRESSION SET

Butyl "O" RINGS



NEW

Another LINEAR first . . . a new, low compression-set Butyl Compound for use in "O" Rings. LINEAR Butyl Compound 7806-70 is a seal material that withstands compression set at elevated temperatures without being permanently deformed or losing its resiliency and its value as a seal. Also, Butyl withstands the chemical actions of the non-flammable phosphate esters such as "Skydrol", "Pydraul", "Celluflex" and "Lindol".

YET, PROVEN

Exhaustive tests, under method "B" of the ASTM, show this new LINEAR compound develops only 30 to 40% compression set after 70 hours at 212°F, as compared to the usual 70 to 95% set experienced with previous Butyl compounds. This unusually good resistance to permanent deformation, combined with a tensile strength of 2000 psi and an elongation factor of 275%, make this material an outstanding one for all "O" Ring applications and other molded shapes where Butyl rubber's excellent qualities are desirable.

Whenever you have a seal problem that is tough to handle—look to LINEAR for an answer. Write, or ask the local representative for complete information on LINEAR's new Butyl Compound 7806-70—today.

"PERFECTION IN RUBBER"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

MOTOR MAINTENANCE TIP:

Use Shovel Regularly

Without the vigorous use of a shovel, this Fairbanks-Morse 100 hp. motor would be buried under corrosive coal dust. Even so, as it drives a briquette press 16 hours a day, there is a cloud of coal dust coating motor windings and inhibiting normal cooling . . . steam and sulphur release sulphuric acid that can cause mechanical and electrical failure.

YET—After eight years in this rugged service the slip-ring motor in its dripproof frame has operated at peak efficiency without a single breakdown. Other F-M motors in this same difficult environment have operated more than 40,000 hours without breakdown—completely eliminating motor failures where such failure was commonplace before.

There is no better way to judge design advantages than to look at the long performance record of equipment in service. Your nearby Fairbanks-Morse Motor Specialists can show you many applications similar to your own.

When Performance Is the Measure,
F-M Motors Are the Standard.

Fairbanks, Morse & Co., Chicago 5, Ill., Dept. ME-11.

FAIRBANKS-MORSE

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ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • PUMPS • SCALES • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

ROTO-FLO
formed parts are produced faster, at lower cost, are stronger than machined parts of the same dimensions, have higher fatigue resistance.
LET US PROVE IT ON Your PARTS
You can now have your own experimental toothed parts (including involute splines, oil grooves, etc.) ROTO-FLO formed
without buying a machine
You can prove to yourself and your company that ROTO-FLO forming will improve performance and life while lowering production costs of
your own actual parts
All you pay for is an experimental pair of racks, and special tooling if needed.
We will roll-form an experimental run of your test parts for you
Our field engineer in your area will be happy to work with you. May we ask him to supply you with complete information?
Please let us know
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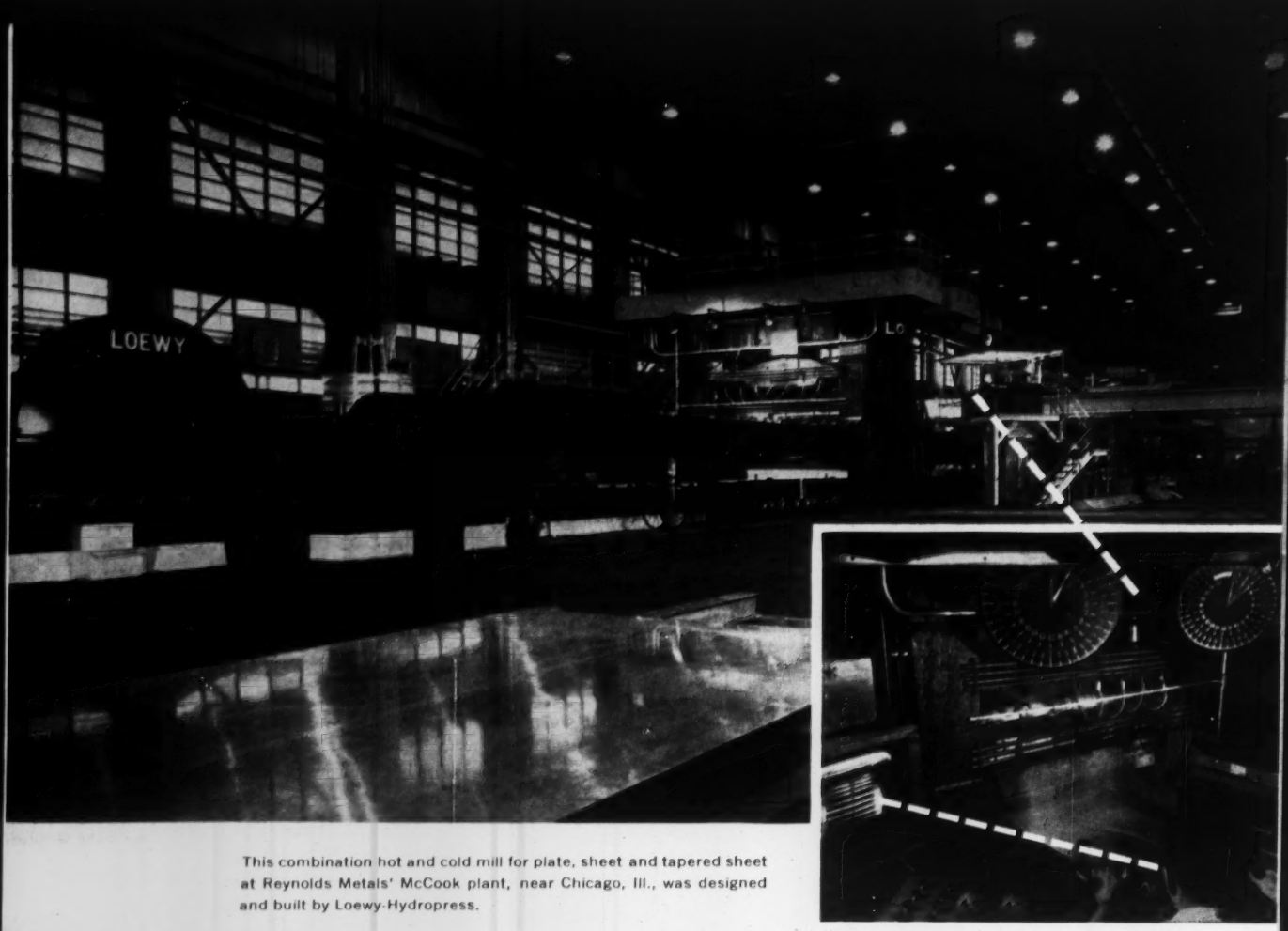


This combination hot and cold mill for plate, sheet and tapered sheet at Reynolds Metals' McCook plant, near Chicago, Ill., was designed and built by Loewy-Hydropress.

Control Station features TV observation.

AT REYNOLDS METALS . . .

Country's largest combination breakdown and plate rolling mill produces finished aluminum plate down to .032 in. thickness

Designed and built by Loewy-Hydropress, this Navy rolling mill—largest installation of its kind in America—permits, in addition to the rolling of thick plate, the hot and cold rolling of aluminum alloy tapered plate and sheet so vital to supersonic speed aircraft.

Cast or prerolled solid ingots or prerolled clad ingots are fed into the four-high mill, which can produce aluminum plate *up to 135 in. wide*. Automatic electronic controls and cold rolling under tension allow sheet and plate to be rolled to precision tapered thicknesses down to .032 in. (cold), with a maximum taper of .25 in. per ft. and a maximum length of 480 in. For hot taper rolling, this length can be considerably increased. Here is evidence of Loewy's creativity in rolling mill engineering.

To individual production requirements, Loewy-Hydropress designs, builds and installs hot and cold rolling mills for ferrous and nonferrous metals; continuous merchant and wire-rod mills; skelp mills; two-high and three-high blooming mills; high speed foil mills; continuous billet and sheet-bar mills; strip, slabbing, plate, structural, rail mills; and special mills. For further information, write us today, Dept. F-11.

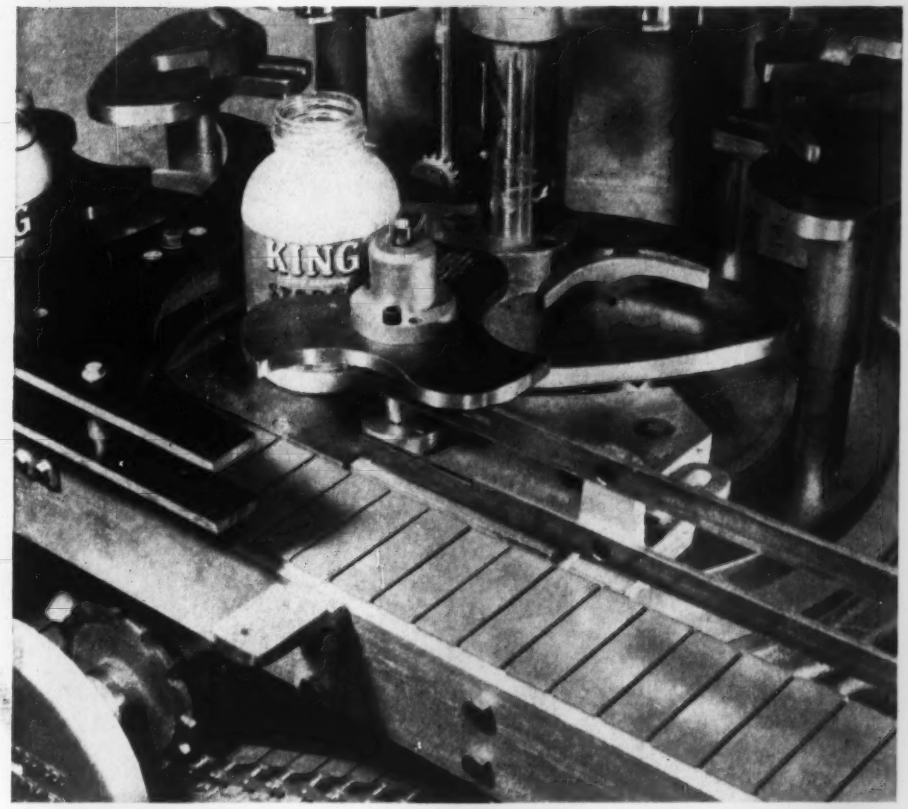
Loewy-Hydropress Division

BALDWIN · LIMA · HAMILTON

111 FIFTH AVENUE, NEW YORK 3, N.Y. Rolling mills • Hydraulic machinery • Industrial engineering

BALDWIN BLH LIMA-HAMILTON

New chain has steel's strength plus nylon's wear resistance



NY-STEEL FLAT TOP CHAIN on Horix Fitting Machine with nine fitter valves. This unit is in service at Mangels Herold Company, Baltimore, manufacturers of King Liquid Laundry Starch.

Link-Belt Ny-Steel flat-top chain fits existing sprockets

Nylon and Steel — Link-Belt combines both in Ny-Steel Flat-Top Roller Chain. This combination gives you a smooth, resilient nylon carrying surface to reduce glass breakage and track wear — plus a precision steel roller chain with the strength and durability to carry heavy loads without stretching. Ny-Steel is less than half the weight of similar all-steel chain — has proven itself ideal for safe, low-cost conveying of bottles, cans and similar items.

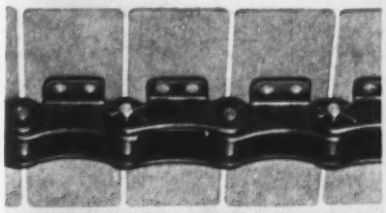
Exceptional wear-life

Long life is one of Ny-Steel's many outstanding features. It resists chemicals and corrosion . . . retains pitch, even under moisture conditions . . . gives long-lasting service with practically no top-plate or track wear.

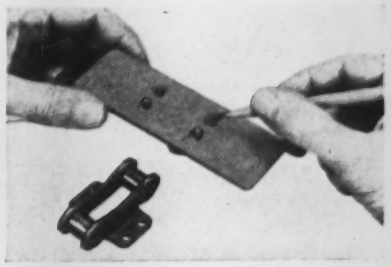
Ny-Steel is easy to install . . . fits existing sprockets. And for new installations or replacements, Link-Belt makes a full line of cut-tooth sprockets. Ny-Steel comes with top plates assembled on either stainless or heat-treated carbon steel chain.

Why Ny-Steel is industry's most advanced flat-top conveyor chain

RIVET-FREE SURFACE — Top plates are of uniform thickness, without rivet pockets or projections. Each is chamfered and mounted level with adjacent plates.



PRECISION STEEL ROLLER CHAIN gives Ny-Steel its great strength . . . facilitates installations and maintenance. Can be easily coupled or uncoupled.



SECURE BONDING OF CHAIN AND PLATE — Underside of each plate is molded with projections that become self-rivets. This leaves surface free of obstructions.

The large picture above illustrates one of many applications of Ny-Steel flat-top chain. Besides being smooth, nylon plates are shock-absorbent . . . assure safe, easy transfer of containers.

Ny-Steel top plates are available in 3¼ and 4½-in. widths. Folder 2492 contains complete dimensions and specifications.

HEADQUARTERS for Link-Belt products is your nearby Link-Belt factory branch store or authorized stock-carrying distributor. Refer to the yellow pages of your local phone directory.

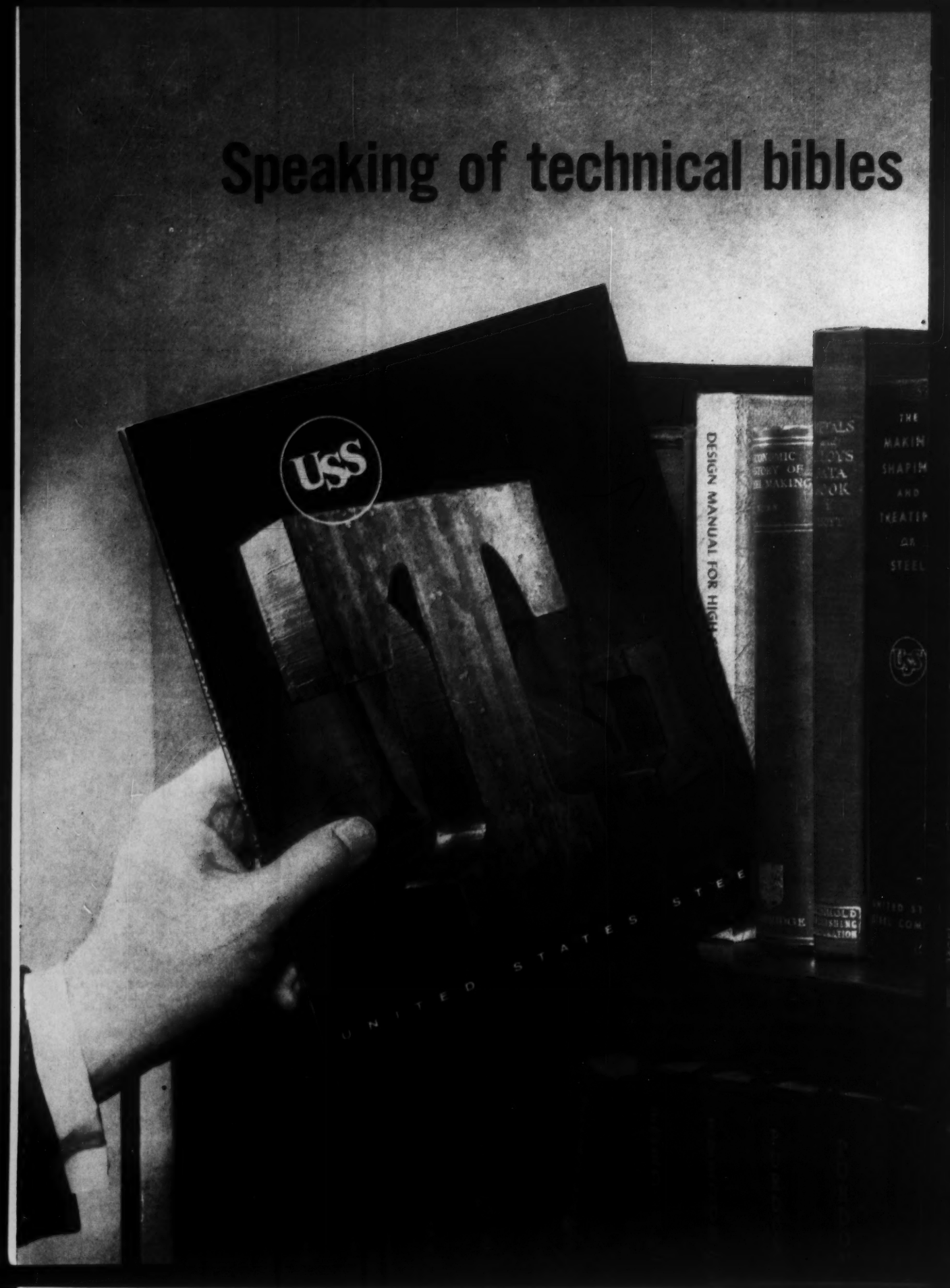
LINK-BELT

THE SYMBOL OF QUALITY — LB — A LINK-BELT

CHAINS AND SPROCKETS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,748

Speaking of technical bibles



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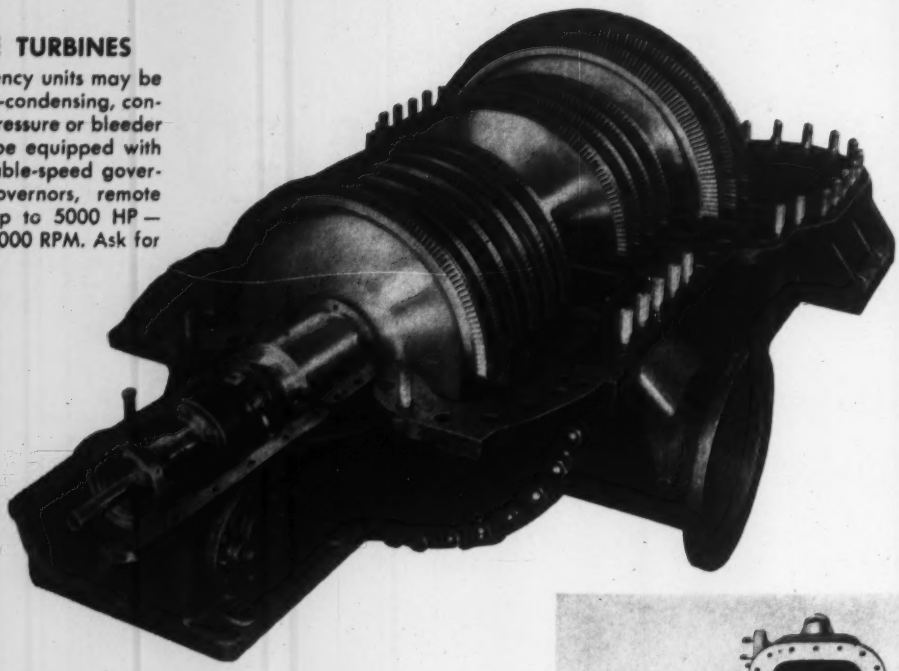
MULTI-STAGE TURBINES

These high-efficiency units may be designed for non-condensing, condensing, mixed pressure or bleeder operation. Can be equipped with constant or variable-speed governors, special governors, remote controls. Sizes up to 5000 HP — Speeds up to 10,000 RPM. Ask for Bulletin S-146.



There's a **Terry turbine** for every mechanical-drive requirement

The designs for Terry turbines are based on more than 50 years of successful experience in the manufacture of turbine drives *exclusively*. This specialization has resulted in Terry becoming one of *the leading producers* of mechanical-drive turbines in sizes up to 5,000 horsepower.

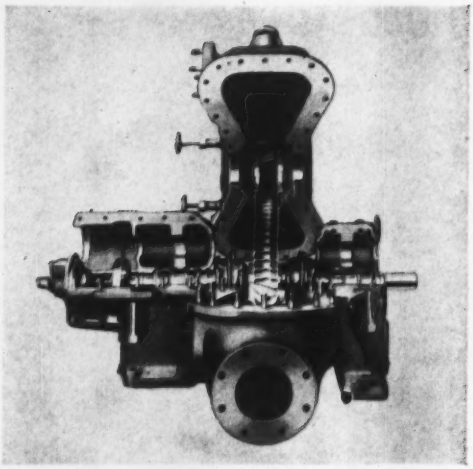
There are three basic reasons why Terry has been able to maintain this position of leadership: (1) a thorough knowledge of the requirements of mechanical-drive turbines, (2) a willingness to build "a little something extra" into each machine to assure trouble-free operation, and (3) an acknowledgement of the company's responsibility to stand behind the performance of every turbine sold.

These are also the reasons why you should consider a Terry turbine for your next mechanical drive. In the meantime, send for bulletins describing any of the types of machines illustrated.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

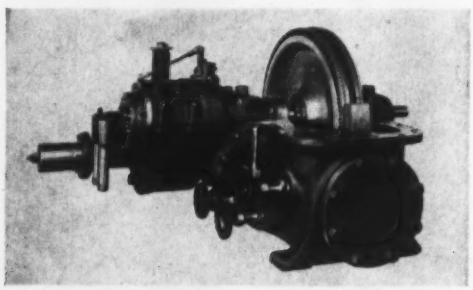
TERRY

TT-1209



SOLID-WHEEL TURBINES

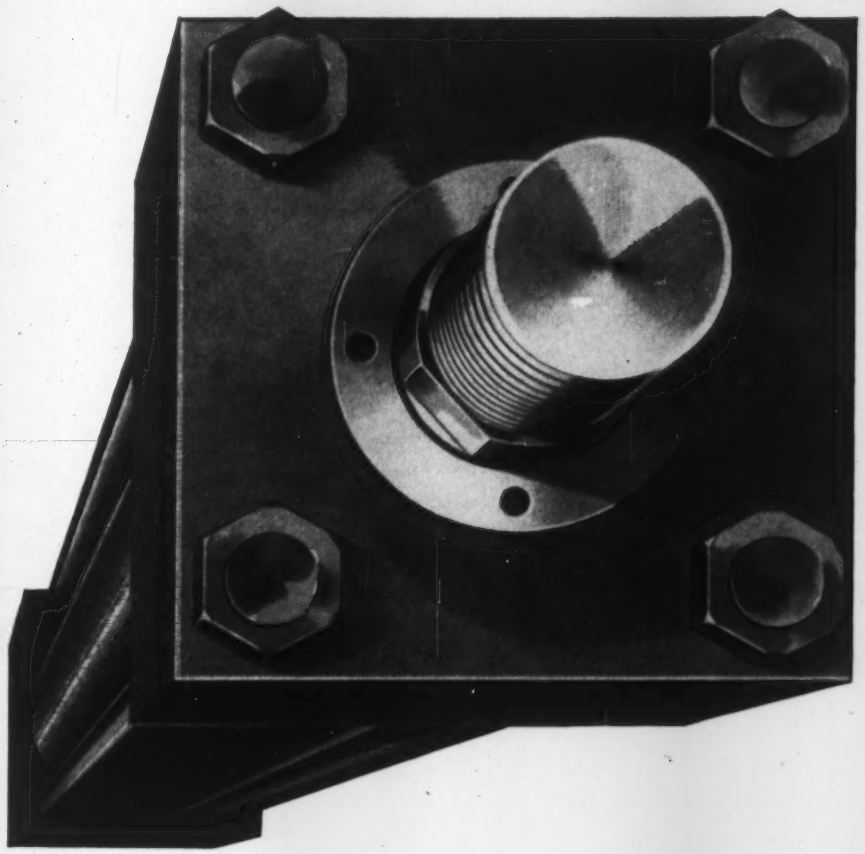
Famous for sure dependability and ease of inspection. Can be started cold — no preliminary warming required. Available in vertical designs depending on frame size. Capacities from 5 to 2,000 HP. Described in Bulletin S-116.



AXIAL-FLOW IMPULSE TURBINES

Built with one, two or three rows of high-grade stainless steel blading, these turbines combine efficiency with durability. Available in designs for moderate and high steam pressure. Bulletin S-143.

AT YOUR REQUEST...



ANKER-HOLTH

Hydraulic Cylinders now available in Square Head design

Positive Trouble-free Performance

Anker-Holth Division, for 18 years designers and manufacturers of quality air and hydraulic power cylinders, now offers a standard line of all steel, high pressure square head tie rod cylinders. Important new operating features and design achievements assure positive controlled power for a wide range of industrial applications.

Standardized Mountings for Interchangeability

Conservatively rated at 2000 P.S.I. working pressure and 3000 P.S.I. non-shock pressure every cylinder is proof tested at 4500 P.S.I. All mountings are available, standard bores from 1½ to 8 inches. Standardized mountings provide complete interchangeability with most makes of square head cylinders. The Anker-Holth "□" line meets all J.I.C. specifications.

For more information contact your local Anker-Holth representative or Anker-Holth Division, Port Huron, Michigan. YUkon 5-7181

ANKER-HOLTH DIVISION

THE WELLMAN ENGINEERING COMPANY

2727 CONNOR STREET, PORT HURON, MICH., U. S. A.

G-E looks

at coal as low-cost fuel

For low-cost steam generation and supply availability, GE burns coal in Louisville

General Electric's Major Appliance Division in Louisville, Ky., has six product manufacturing buildings, a warehouse and service buildings—5 million sq. ft. under roof. To generate all steam necessary for process work and heating requirements of this vast area, GE's power plant burns coal the modern way. Coal was chosen for availability and economy. A careful fuel cost study disclosed that, in the Louisville area, coal would give GE the lowest-cost steam generation of all fuels. In addition, full mechanization of GE's power plant has facilitated all details of coal handling and ash removal while completely overcoming the problem of air pollution.

Facts you should know about coal

Not only is bituminous coal the lowest-cost fuel in most industrial areas, but up-to-date coal burning equipment can give you 10% to 40% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at a stable price.

Technical advisory service

The Bituminous Coal Institute offers a free technical advisory service on industrial fuel problems. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

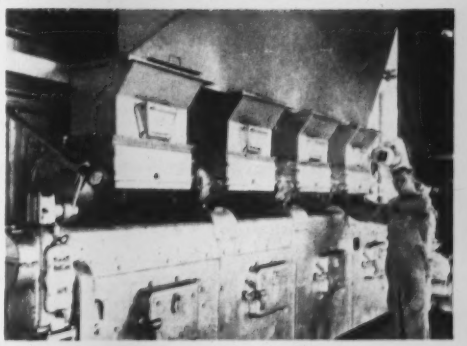
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

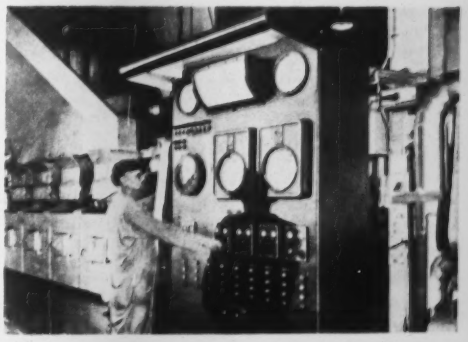
BITUMINOUS COAL INSTITUTE

Southern Building • Washington 5, D.C.

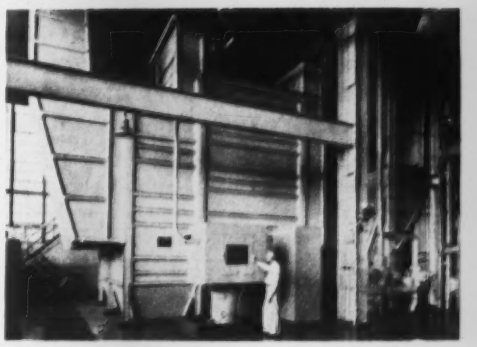
Note cleanliness of firing aisle of GE's power plant. Steam generating equipment consists of five 150,000 lbs./hr. boilers—three by Henry Vogt Machine Co. and two by Riley Stoker Corp.



Close-up of Detroit Rotograte Spreader Stoker on a Henry Vogt boiler. Riley boilers are fired by Riley Spreader Stokers. These stokers operate automatically, with continuous ash discharge. All boilers are equipped with non-segregating chutes.



Control panel for Boiler #5. These are Bailey Meter controls, air-operated, automatically handling coal feed, induced and forced draft, overfire air and feedwater regulation.



Prat-Daniel Electrostatic Precipitator and controls; at right, mechanical precipitator by American Air Filter Co. These are connected in series for automatic, efficient fly ash collection and disposal.

Hyatt's Simplified Fitting Practice for Bearing Races

HYATT pioneered the use of carburizing type alloys in order to obtain the advantages of heavier race fits

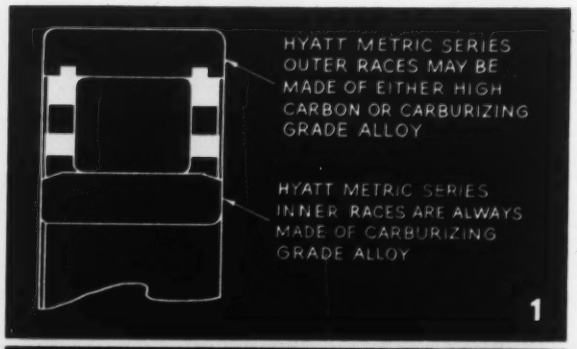
To obtain the best possible performance, roller bearing races must be assembled on shafts and in housings with certain fits developed by design and experience. The most frequent condition to be met is a rotating shaft where specific load and speed conditions must be satisfied with appropriate race fits. These vary according to the manufacturer, and in the case of some manufacturers, according to the application. Naturally, the fits will also vary according to bearing type and size.

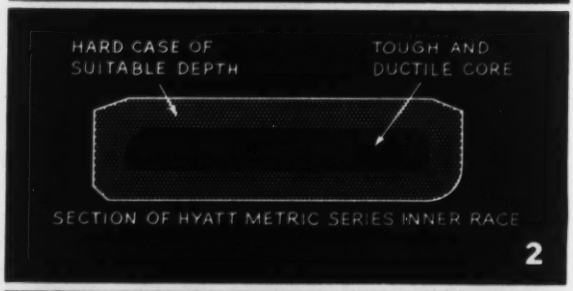
1. CARBURIZING PERMITS HEAVIER INTERFERENCE FITS

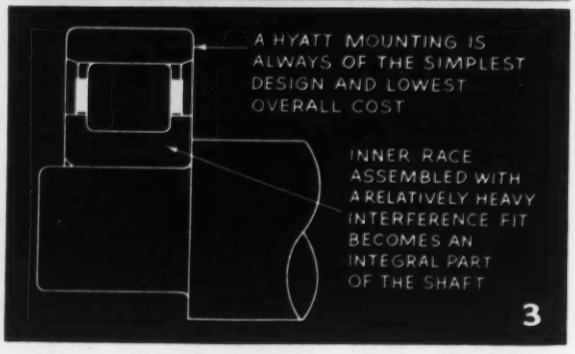
Taking the standard metric series of cylindrical roller bearings for an example, the bearing user has the choice of two fitting practices. One involves the use of inner races made of through-hardening steel, which dictates fairly light interference fits to avoid splitting. The other utilizes races made of low carbon steel *carburized* and hardened to develop a suitable surface hardness and a tough ductile core. The latter permits much heavier interference fits and has the additional advantage of eliminating all auxiliary holding devices, because the race becomes practically an integral part of the shaft. (Figs. 1, 2.)

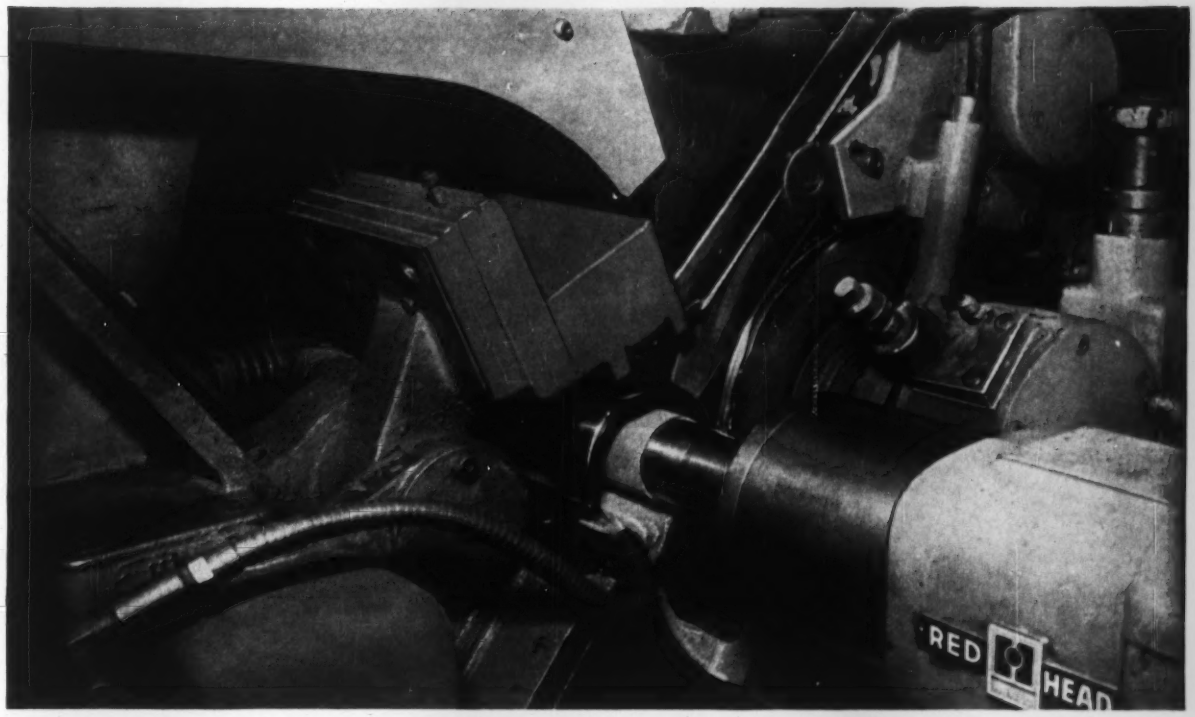
2. HEAVIER FITS SIMPLIFY MOUNTING, REDUCE COSTS

Hyatt originated the carburized race and the system of relatively heavy inner race fits to simplify bearing mounting and eliminate the need for retaining devices. Practically all HYATT inner races are made from nickel alloys of the carburizing type. They permit mountings of the simplest type and lowest over-all cost. Furthermore, the shoulders of HYATT carburized races will withstand considerably greater impact loads than will ordinary races. (Figures 3 and 4.)


HYATT METRIC SERIES OUTER RACES MAY BE MADE OF EITHER HIGH CARBON OR CARBURIZING GRADE ALLOY
HYATT METRIC SERIES INNER RACES ARE ALWAYS MADE OF CARBURIZING GRADE ALLOY
1




A HYATT MOUNTING IS ALWAYS OF THE SIMPLEST DESIGN AND LOWEST OVERALL COST
INNER RACE ASSEMBLED WITH A RELATIVELY HEAVY INTERFERENCE FIT BECOMES AN INTEGRAL PART OF THE SHAFT
3

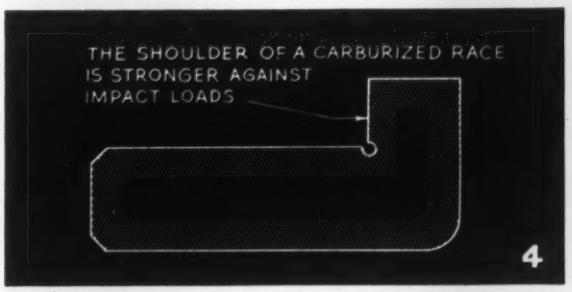


Hyatt inner race being centerless I. D. (inside diameter) ground to close tolerances.

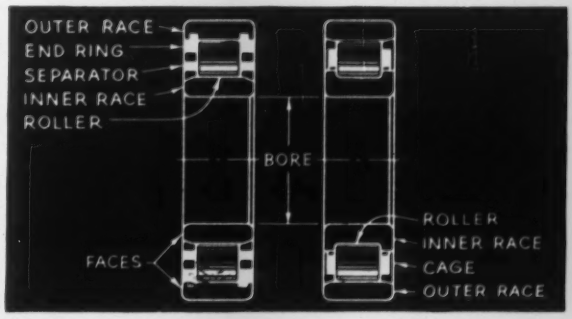
There are two fitting specifications which apply to HYATT inner races, depending on whether the inner race rotates or is stationary in operation. Remember, with both inner and outer race, the rotating member is assembled with heavier fit.

3. HYATT INNER RACES CAN BE EASILY SHRUNK ON SHAFTS

HYATT inner races may be mounted on shafts by pressing or shrinking. Where shrinking practice is employed, first heat the race in oil held at a temperature not over 300°F, or in an electric oven under a similarly controlled temperature, until it expands sufficiently to be slipped into position. The required interference fit will develop as the race cools in place. For special conditions of fit involving hollow shafts of varying sections or multiple housings of dissimilar metals, consult your HYATT Sales Engineer from our nearest sales office.



COMPONENT PARTS OF A HYATT ROLLER BEARING

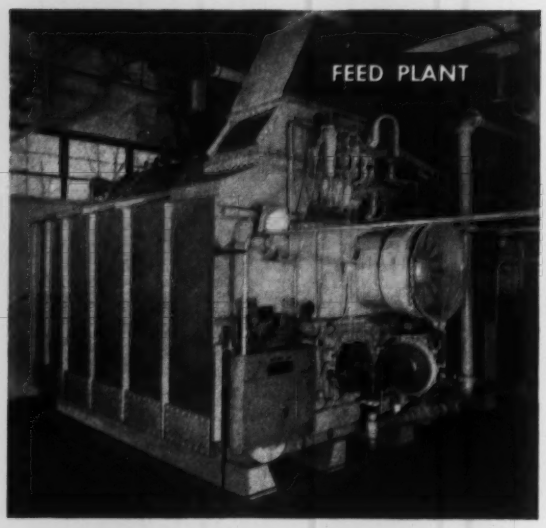


YOU WILL FIND MORE DETAILS in HYATT Catalog No. 150. If you do not have a copy, write Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey. Sales offices at Harrison, Pittsburgh, Chicago, Detroit and Oakland, California.

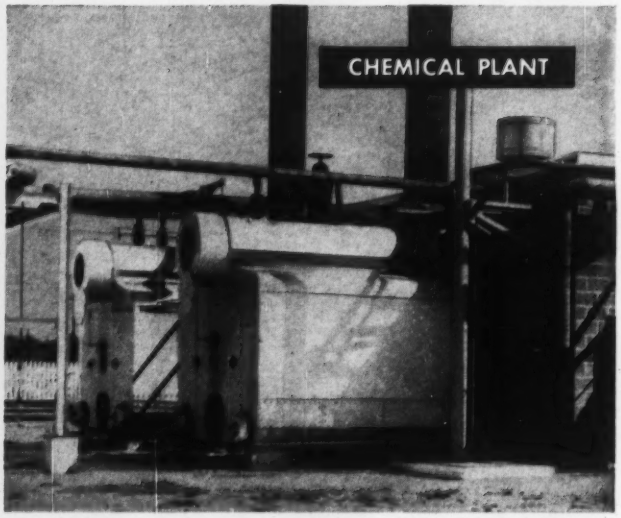
GM GENERAL MOTORS

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY

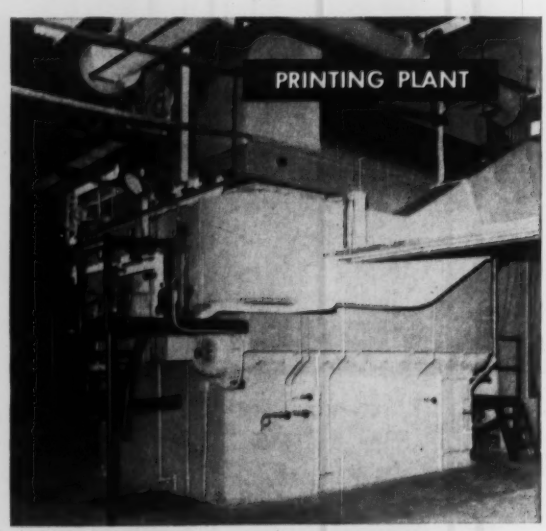
Here's how industries are profiting



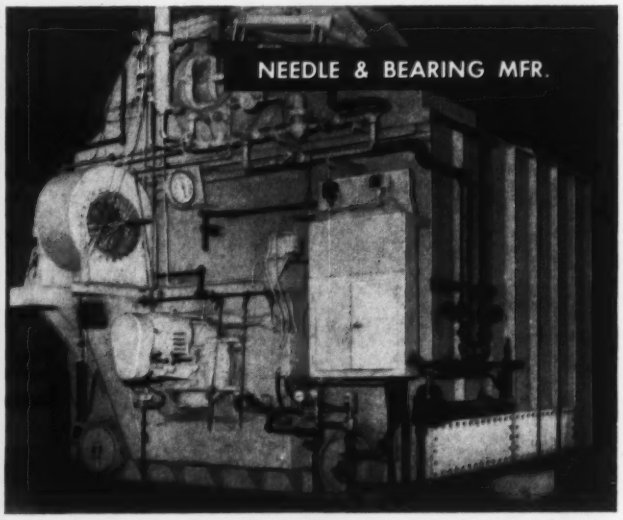
PROVED "DEPENDABLE" IN MODERN FEED PLANT
Playing a dual role in the manufacture of livestock and poultry feed, this is one of two Union Type MH Steam Generators producing steam for processing milk by-products and for providing space heat. Selected "on the basis of good design" by Consolidated Products Co. for its Springfield, Mo. plant, these 22,000 lb./hr. packaged units are reported to "have proven very satisfactory and dependable sources of steam."



"EFFICIENCY HIGH" ON OUTDOOR ASSIGNMENT
That's what Davison Chemical Company, Division of W.R. Grace & Co., has to say about these two Union Type MH Steam Generators. Delivering process steam, this pair of 18,000 lb./hr. packaged boilers handles an important job in Davison's large Lake Charles, La. plant which is equipped to produce approximately 45.000,000 lbs. of petroleum cracking catalysts annually. Selected because of "reputation . . . and delivery," both of the units were shop-assembled in Erie, Pa. before delivery to the job site.

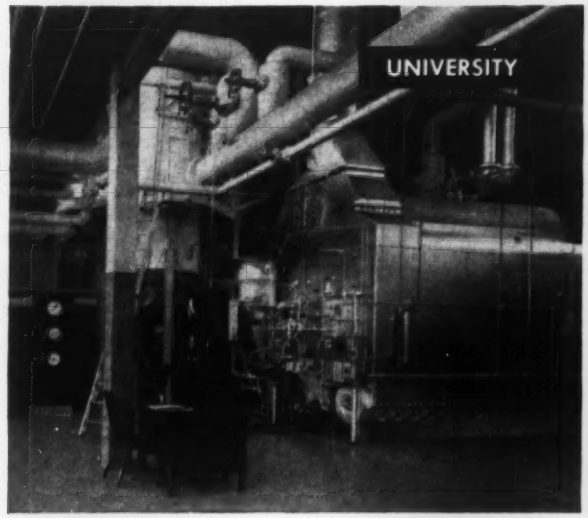


PACKAGED AIR HEATER ADDED FOR 85.79% EFFICIENCY
Here's one of the many ways Union can supply auxiliary equipment with a completely shop-assembled MH Steam Generator to handle special needs formerly requiring costly field erection and special engineering. Serving Western Printing and Lithography Co., this 20,000 lb./hr. unit "has proven very satisfactory." Western also adds, "It was sold to operate at 85% efficiency and is doing that."

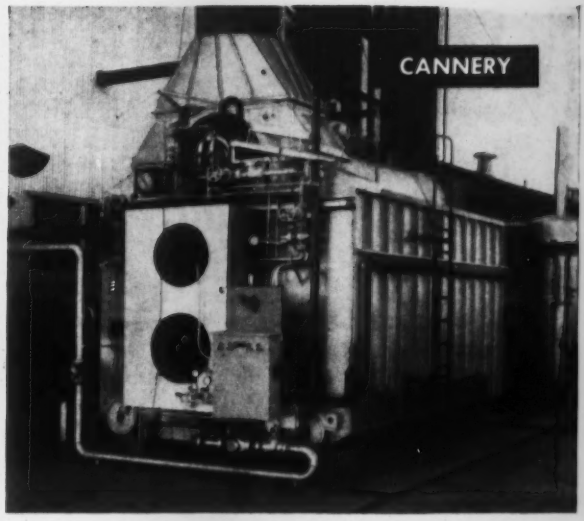


20,000 LB./HR. "MH" SAVES $12,500 IN YEAR
Because "construction and design appeared better than others and physical size fit into plant," a 20,000 lb./hr. Union Type MH Steam Generator was installed in the Excelsior plant of The Torrington Company in October, 1955. In short order, the new boiler proved its worth. When a second MH (15,000 lbs./hr.) was installed in October 1956, Torrington said this about the first: "Estimated savings for the first year are $12,500, as compared to our old coal burning hand fired boilers."

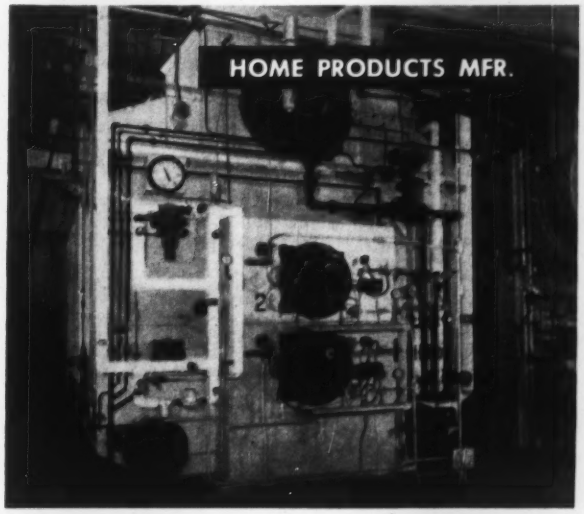
with Union Packaged Boilers



SCORE "BETTER THAN 80%" ON EFFICIENCY TESTS
Providing space heat for 14 buildings on University of Toledo's 170-acre campus, two 28,000 lb./hr. Union Type MH Steam Generators also take part in the educational process. Utilized for laboratory work by mechanical engineering students, these Union Packaged Boilers are reported to operate at "better than 80% efficiency." Says the University, "We get 128 lbs. of steam per gallon of fuel oil as compared to 93 lbs. per gallon with the old boilers formerly used."



ONE "MH" LEADS TO ANOTHER
Tri-Valley Packing Assoc. uses a pair of Union 30,000 lb./hr. Packaged Steam Generators. In 1953, Tri-Valley's first MH Unit went to work in the Association's Modesto plant. When the San Jose plant needed a new boiler in 1955, another Union Packaged Boiler (shown above) was picked for the job. Says Tri-Valley, "Our selection was based upon our evaluation of the design . . . and the performance of the MH Packaged Boiler installed in our Modesto plant."



THRIFTY — LIKE THE PRODUCTS OF ITS USER
On duty at the Easthampton, Mass. plant of Stanley Home Products, Inc., this 35,000 lb./hr. Union MH Steam Generator was selected for "its well-balanced design, neat appearance and adaptability to burning oil, gas or coal" plus the fact that "design and connections permitted the quickest and least costly installation." With the MH operating over a range from 5,000 thru 35,000 lbs./hr., Stanley reports "considerable savings in fuel with an increase in production."

HOW ABOUT YOU?
Like more facts on Union's popular MH? Full details including cut-away illustrations, tube layouts and dimension tables for all 13 sizes (10,000 thru 60,000 lbs./hr.) can be obtained by requesting Bulletin MH-353.

Get the full story by mailing this coupon

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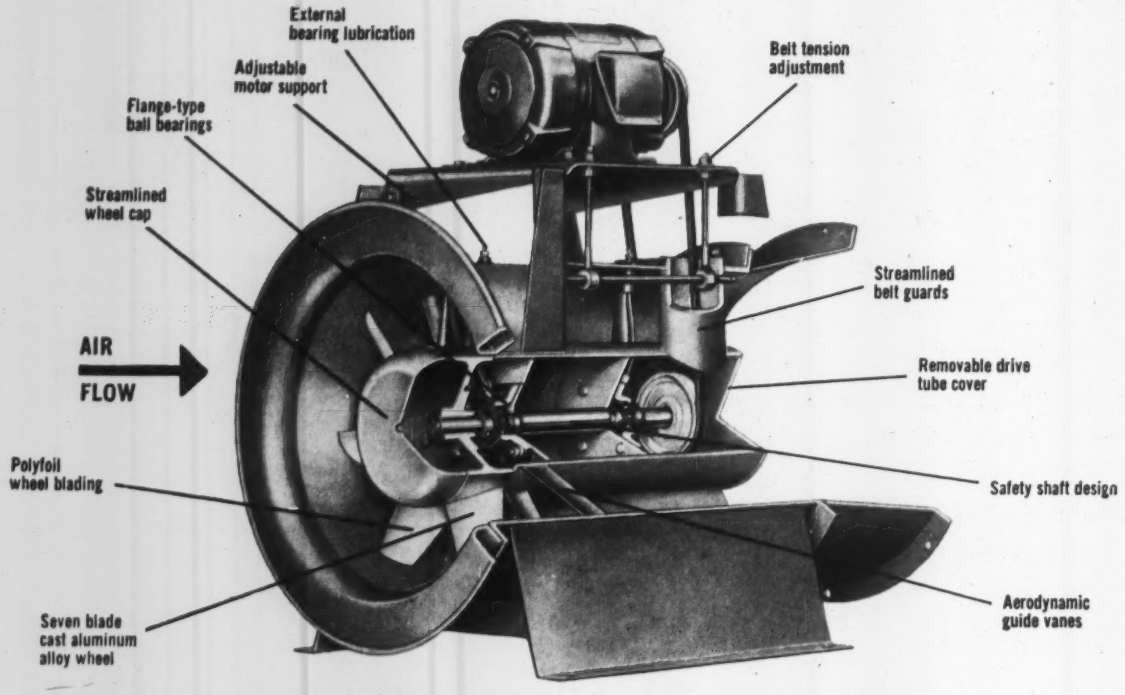
for Industrial air, fume, vapor handling jobs!



CUTAWAY VIEW OF WESTINGHOUSE AXIFLO® VANEAXIAL FAN FOR GENERAL APPLICATION.

COMPLETE NEW LINE

With: volumes from 1,700 to 100,000 CFM—static pressures up to 3¼"—14 sizes, Vaneaxial or Tube Axial, direct-connected or V-belt driven, with wheel diameters from 15" to 72".

- **Space Saving** . . . compact Axial Flow design permits installation directly into duct work.
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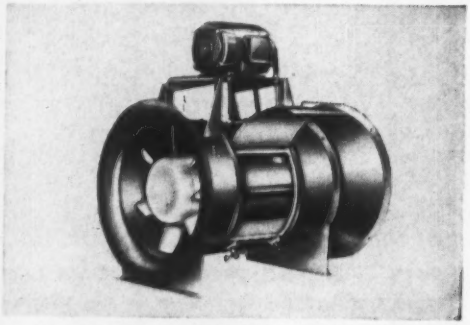
- **Least maintenance** . . . rugged practical construction insures continuous trouble-free operation.

For complete application service, call your nearest Sturtevant Division Sales Engineer, or write Westinghouse Electric Corporation, Dept. 23E, Hyde Park, Boston 36, Massachusetts.



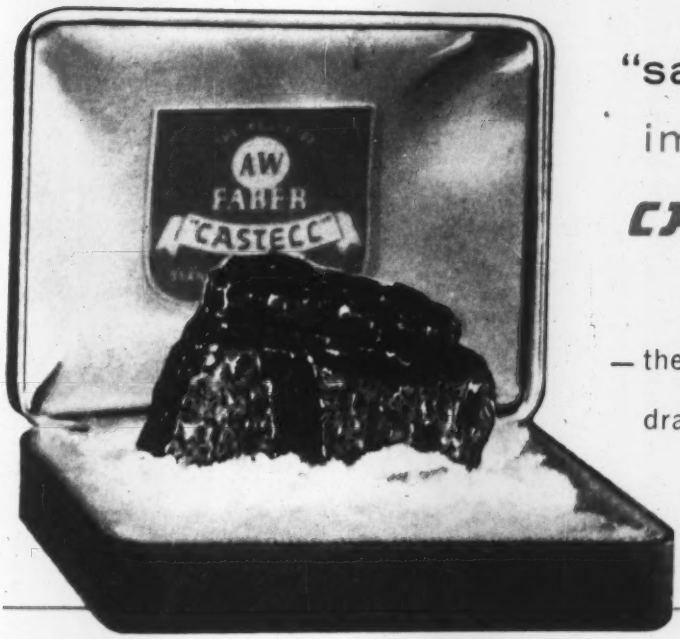
Spray booth Vaneaxial Fan specially designed to provide easy access required for paint spray exhaust!

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S Westinghouse

J-80592EA

"BLACK GOLD" . . . the best natural graphite of more than 99% carbon . . .



"saturates" imported **CASTELL**

— the world's finest drawing pencil

Mined out of the earth just as any precious mineral, CASTELL **"black gold"** graphite tests out at more than 99% pure carbon.

In its virgin state it is the purest black known to man. There is no need for us to add foreign oily substances to CASTELL. Nature at her best is beyond improving. Our job is to apply almost 200 years of pencil-making experience to refine this "black gold" into 20 superb tones, 8B to 10H — each degree as uniform as a platoon of West Point cadets.

Make a series of single or multiple pass lines with your favorite CASTELL degree. Now examine them through your magnifying glass. Notice the bold, black, close-textured saturation, the identical width in line after line. You owe it to your career to use CASTELL, the drawing pencil of the Masters. Good dealers everywhere carry CASTELL. Phone *yours* today.

CASTELL LOCKTITE (with Tel-A-Grade Indicator) for those who prefer a feather-weight holder with degree indicating device. Grips the lead like the jaws of a bulldog to prevent slipping or turning. One hand push-button control reduces graphite stains.

Imported CASTELL 9030 Lead — with the identical graphite that made Castell wood pencil world famous. Usable in all standard holders, but a perfect mate with LOCKTITE. Also available in a kaleidoscope of colors. Packed in plastic tube, 12 leads each.

A.W.FABER • CASTELL

NEWARK 3, N. J.

The Proudest Name in Pencils

Castell in Canada • Write Hughes Owens Co., Ltd., Montreal

PREFERRED BY PROFESSIONALS IN EVERY CIVILIZED COUNTRY ON EARTH.

If you are boosting capacity . . .

New refining processes usually call for completely new equipment or drastic revamps of existing facilities.

That's why it's a good idea to get in touch with Bigelow-Liptak when furnace enclosures are being considered. Modernization of your present equipment will assure keeping pace with production demands and save money to boot.

When new enclosures are needed, B-L can design—furnish quality controlled materials—and erect. One source for everything—one responsibility for the job—saves you plenty in the long run.

Better investigate right now. Just write.

BIGELOW-LIPTAK
CORPORATION
AND BIGELOW-LIPTAK EXPORT CORPORATION
13300 PURITAN AVENUE, DETROIT 27, MICHIGAN

UNIT-SUSPENDED WALLS AND ARCHES

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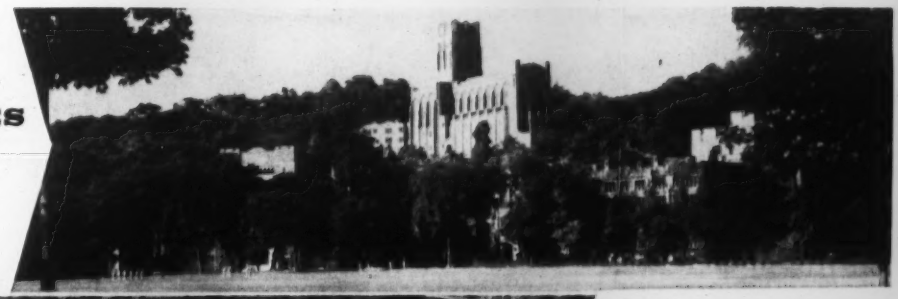
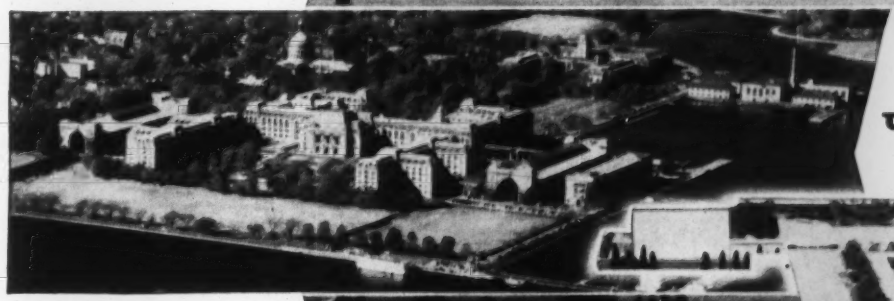
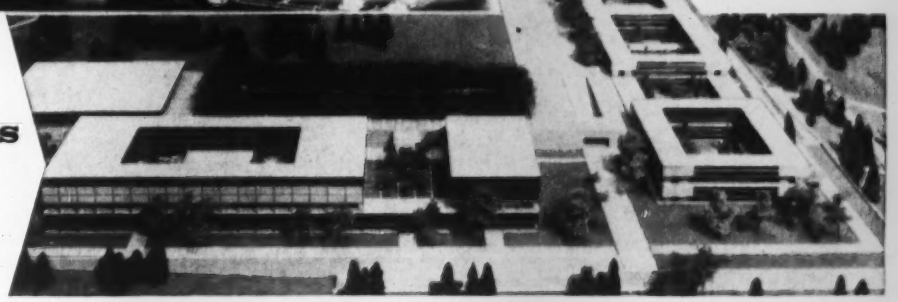
UNITED STATES MILITARY ACADEMY





UNITED STATES NAVAL ACADEMY

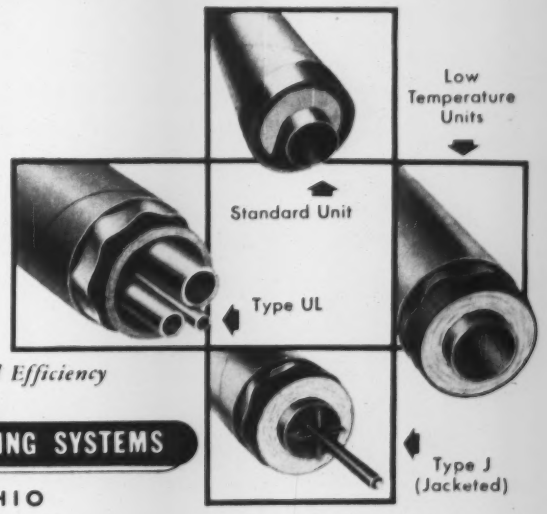
UNITED STATES AIR FORCE ACADEMY



Photographs courtesy United States Military Academy, United States Naval Academy, and United States Air Force Academy.

Ric-wiL underground piping systems serve ALL three...West Point, Annapolis and NOW...the new Air Force Academy

West Point and Annapolis have been serviced by Ric-wiL piping systems as far back as 1931. Since 1946 alone over 15,000 feet of Ric-wiL prefabricated piping has been purchased for the nation's top military colleges. Installation of Ric-wiL piping at the new 17,500 acre United States Air Force Academy has already been installed. Ric-wiL is indeed proud of the part they have played in serving these military academies for a period of over twenty-five years.



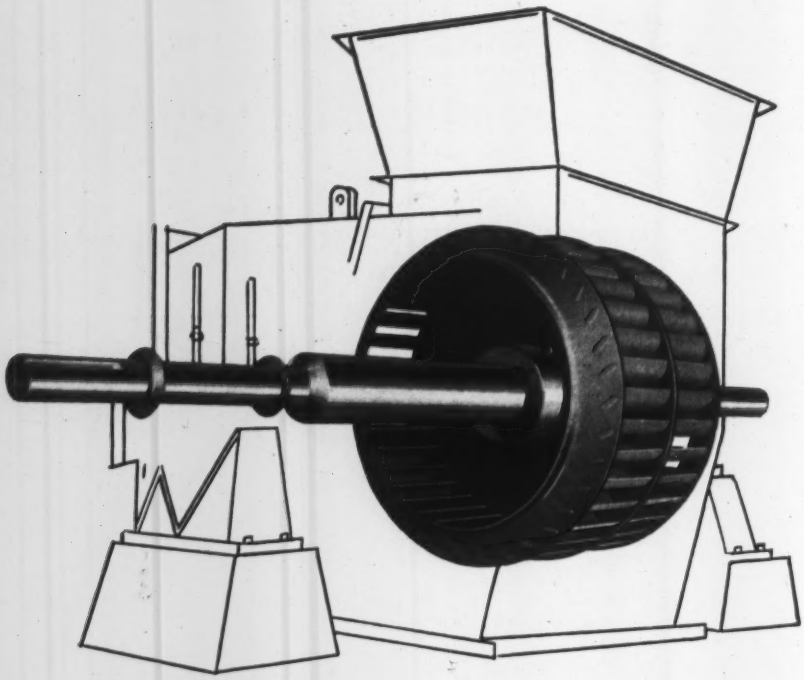
Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

SINCE 1910

RIC-WIL INCORPORATED — PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED



CLARAGE TYPE DN DYNACURVE FAN OFFERS A *New Concept* IN INDUCED DRAFT WHEEL DESIGN

36 radially deep, aerodynamically curved blades impart a dynamic energy to the gas stream to achieve low tip speed operation.

Unique shape of the blades and rims minimizes shock losses and turbulence at the entering edge of the blades and between the blades.

Wheel design assures relatively low moment of inertia (WR^2).

Wheel is constructed with a heavy forged steel hub and a sturdy centerplate.

All welded construction of the wheel provides ample shear strength, tensile strength, and rigidity.

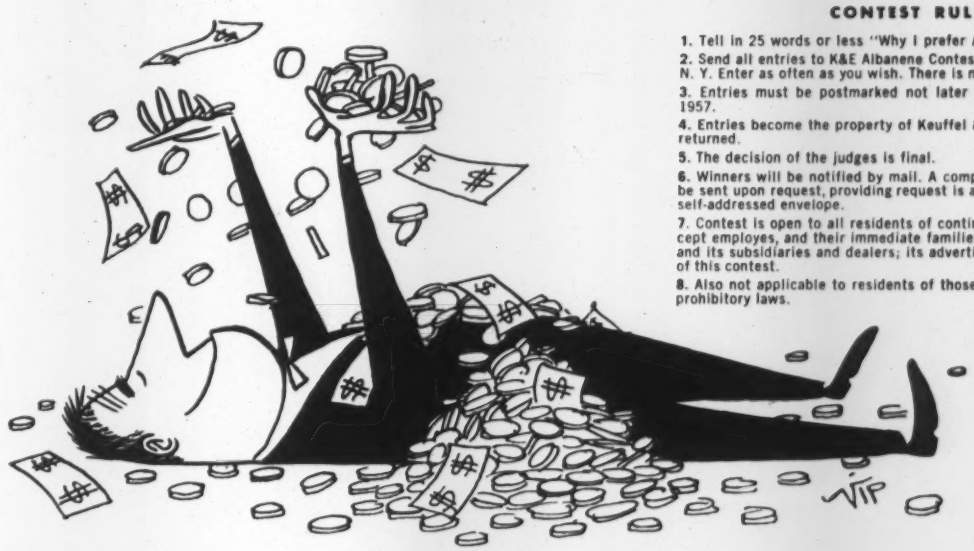
These are only a few of the features that make Clarage's new Type DN Dynacurve Fans fully equal to the most punishing demands.

Write today for Bulletin 905. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

ENTER THIS CONTEST ...90 CASH PRIZES!



CONTEST RULES

1. Tell in 25 words or less "Why I prefer Albanene tracing paper."
2. Send all entries to K&E Albanene Contest, Box 160, New York 46, N. Y. Enter as often as you wish. There is nothing to buy.
3. Entries must be postmarked not later than midnight, Nov. 30, 1957.
4. Entries become the property of Keuffel & Esser Co. None can be returned.
5. The decision of the judges is final.
6. Winners will be notified by mail. A complete list of winners will be sent upon request, providing request is accompanied by stamped, self-addressed envelope.
7. Contest is open to all residents of continental United States, except employes, and their immediate families, of Keuffel & Esser Co. and its subsidiaries and dealers; its advertising agency; and judges of this contest.
8. Also not applicable to residents of those states where there are prohibitory laws.

Why I prefer **ALBANENE**® Tracing Paper...

First prize **$1500**
Second prize **$1000**
Third prize . . . . . **$ 500**

plus 87 prizes of $25 each!

In 25 words or less, tell us why you prefer K&E Albanene® tracing paper. Your reasons may win one of these 90 prizes (it's K&E's 90th anniversary).

Here's a hint: Albanene is made from 100% rag stock for superlative tear strength. It is permanently transparentized with an inert resin. Draftsmen like it because of its easy drawing qualities . . . reproduction men for its high transparency and permanence. Everybody likes it because "what you pay for stays in the paper." That's why Albanene is the best seller among *all* tracing papers.

Get contest aids from your K&E dealer: Information booklets, extra contest entry blanks, samples of Albanene, too, if you need them. You can enter as often as you please.

Or use a plain sheet of paper if someone's already snipped the blank below. Give your name, address, and firm name, twenty-five words or less telling why you prefer Albanene tracing paper, and mail to K&E Albanene Contest, Box 160, New York 46, N. Y. before midnight, November 30, 1957.

KEUFFEL & ESSER CO.
New York, Hoboken, N. J., Detroit, Montreal, Chicago, St. Louis, Dallas, San Francisco, Los Angeles, Seattle.
Dealers in principal cities

K & E Albanene Contest, Box 160, New York 46, N. Y.

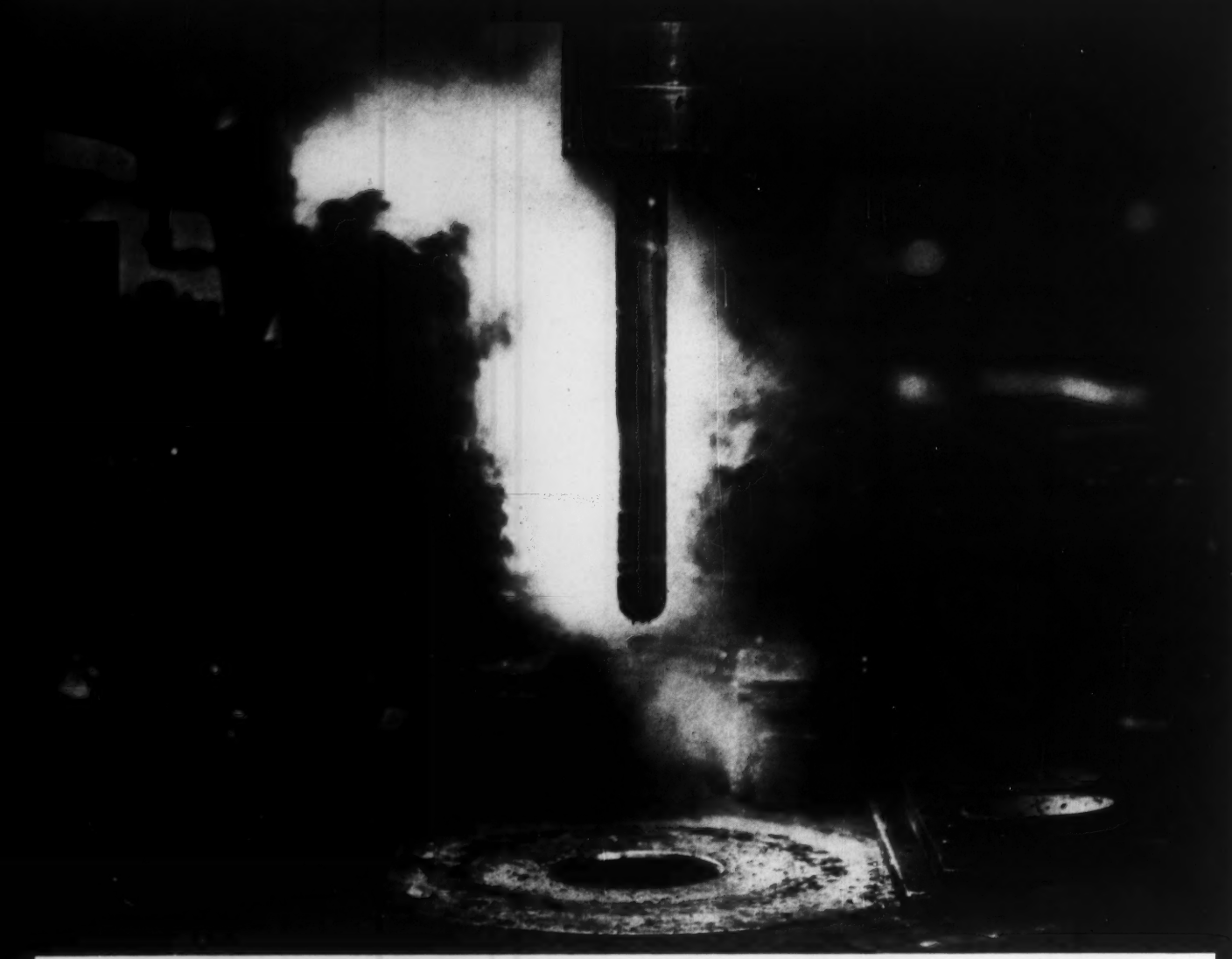
Here's why I prefer Albanene Tracing Papers_____

_____

_____

*Name*_____ *City*_____ *Zone*_____ *State*_____

*Street*_____ *Firm Name*_____



Tough 2½" diameter mandrel at Rc 44 on 1150 ton brass extrusion press. Scovill Manufacturing Co.

Mandrel of HALCOMB 218 retains toughness and hardness at hot work temperatures...

This mandrel is made of Halcomb 218—a tough, air-hardening hot work steel. Halcomb 218 is suitable for tools like this which require a higher degree of toughness at moderately elevated temperatures than is obtainable with the tungsten types of hot work steels. And Halcomb 218 *retains both* its hardness and strength at these temperatures.

For example, at a hardness of Rc 44, Halcomb 218's Charpy Impact Strength is 33 ft-lbs at 500F. And it will retain this hardness after 1 hour, after 10 hours and even after 100 hours at temperatures up to 900F.

Properties like these cut tooling costs. The mandrel shown above is good for 1200 pushes, for example, and even then all it needs, usually, is repolishing before being used again.

Halcomb 218 is particularly useful for all hot work operations on which drastic coolants are used. It even resists breaking very successfully when water cooled in operation. If these sound like advantages you can use, call your local Crucible representative for more complete data. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

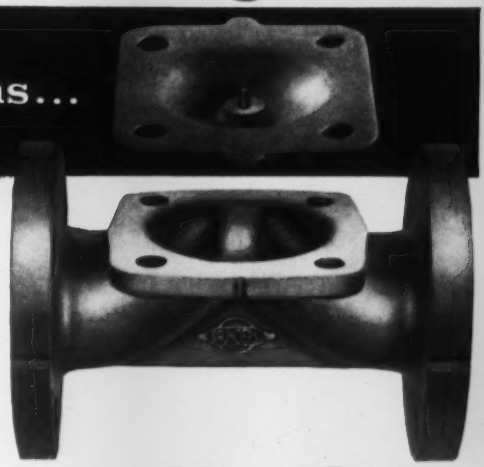
Canadian Distributor—Railway & Power Engineering Corp., Ltd.

Outperforms other valves under SEVERE chemical conditions

GRINNELL-SAUNDERS DIAPHRAGM VALVES

Backing Cushion

with TEFLON Diaphragms...

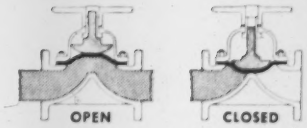


Grinnell Teflon Diaphragms are made by a special process which produces a better product of greater density, toughness and flex life.

The four case histories cited below demonstrate that Teflon offers a very high degree of chemical inertness to some of the most difficult chemicals which industry today must handle. Yet these are only a few of many success stories in the Grinnell files.

Diaphragm life depends on temperature, pressure and frequency of operation. Inquiries must include complete service data to receive prompt and careful attention.

Service Conditions	Saunders Valve Now Used	Service Life: Teflon Diaphragm	Service Life: Previous Valve
Case 1. Benzene hexachloride (30%-40% benzene, free chlorine); 120 to 130 F, 10 to 20 psi; operated 3 to 4 times daily	Glass lined bodies; Teflon Diaphragm; 1 to 3 inches	10 to 14 mos.	1 to 2 mos.
Case 2. 90%-95% HNO_3 plus 1.8% HF (specific gravity 1.62–1.77) 115 F in summer; 40 F in winter; 125 psi; operated 2 to 3 times daily	Durimet 20 body; Teflon Diaphragm; 1 to 3 inches	8 months	2 months
Case 3. AlCl + z complex; ambient to 220 F; 0-50 psi; operated 1 to 2 times daily	Glass lined bodies; Teflon Diaphragms; 1 to 4 inches	9 months	6 months
Case 4. Sulphuric acid 85%; outside temperature; no pressure; operated 4 times daily	Iron bodies; Teflon Diaphragms; 2½ inches	Still in service after 1 year	3 weeks



Features of Grinnell-Saunders Diaphragm Valves

- Diaphragm lifts high for streamline flow in either direction.
- Body, linings and diaphragm materials to suit service conditions.
- Resilient diaphragm assures positive, leak-tight closure even with grit or scale in the line.
- Diaphragm absolutely isolates working parts from fluid . . . sticking, clogging, contamination, corrosion eliminated.
- Simple maintenance. Diaphragm can be replaced easily without removing valve from the line. No packing glands to demand attention. No metal-to-metal seats to become damaged or wire-drawn.

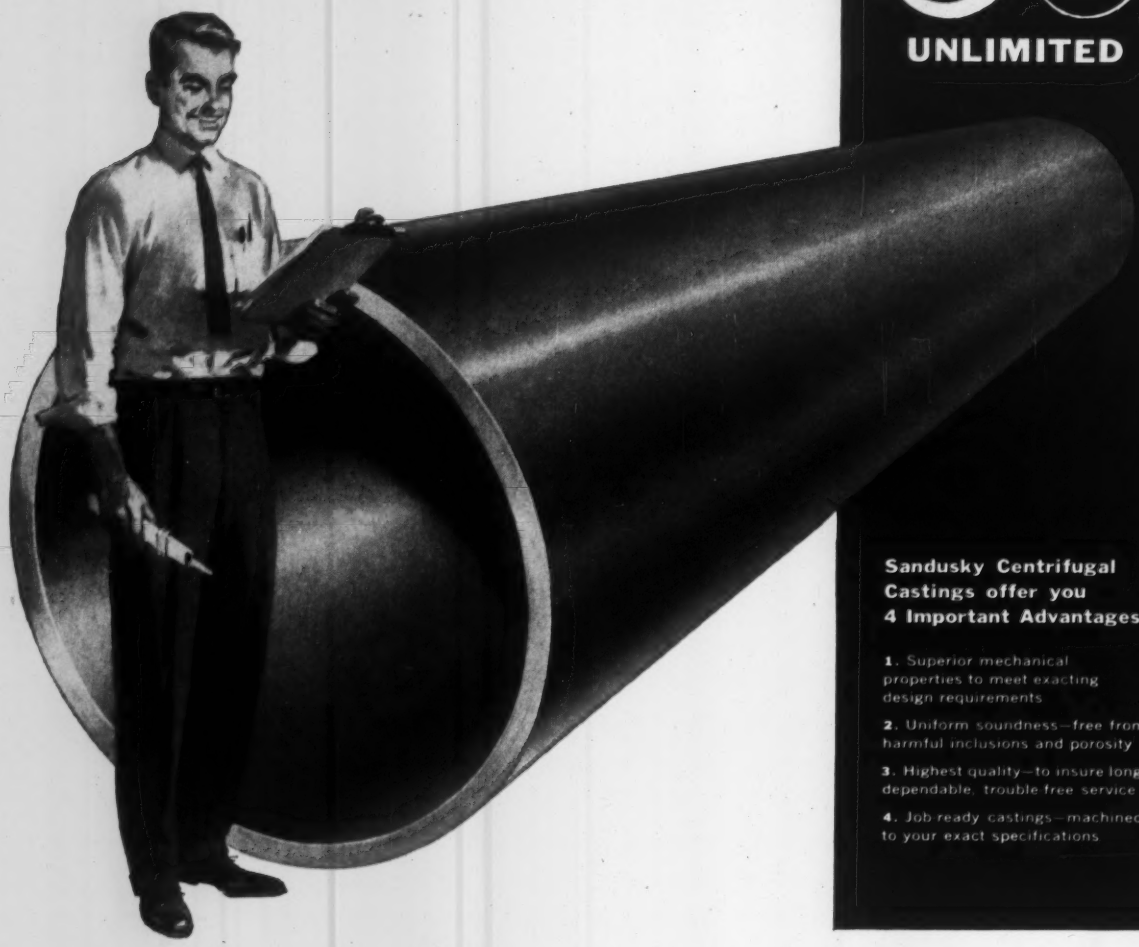
GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

CYLINDRICAL APPLICATIONS:



∞ UNLIMITED

Sandusky Centrifugal Castings offer you 4 Important Advantages

1. Superior mechanical properties to meet exacting design requirements
2. Uniform soundness—free from harmful inclusions and porosity
3. Highest quality—to insure long, dependable, trouble-free service
4. Job ready castings—machined to your exact specifications

More and more design engineers are realizing that new applications for centrifugal castings are *unlimited* . . . thanks to new knowledge about alloys . . . new casting and machining techniques and facilities.

From simple bushings to atomic reactor components . . . from bronzes to heat, corrosion, and abrasion resistant stainless steels . . . from 7″ to 54″ O.D. and lengths to 33 ft.—Sandusky centrifugal castings are providing gratifying results in scores of applications, many unheard of a few years ago.

What cylindrical or piping problem can we help you solve? . . . Code pressure vessels? . . . Reactor vessels? . . . Power Piping? . . . What is your problem?

Your inquiry will bring more information promptly . . . or, if you prefer, a personal call by one of our engineers.

CENTRIFUGAL CASTINGS

Sandusky Foundry & Machine Company

SANDUSKY, OHIO • Stainless, Carbon, Low Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys

BS&B
Is Always Close At Hand . . .

For Experienced Consultation and Prompt Service on Your Control and Safety Head Requirements!

A glance at the map above will tell you that no matter where you are, BS&B Automatic Control and Safety Head sales and service is nearby. What it can't show you is the speed, efficiency and convenience of the BS&B service you get . . . and the years of experience, combined with BS&B's modern research and development facilities, which back *BS&B products: AUTOMATIC CONTROLS for the regulation of pressures, temperatures, liquid levels and flow and SAFETY HEADS for pressure relief, protecting pressure vessels and systems against sudden buildups of overpressure.*

Whether you need service on existing equipment or help in planning new installations, our nearest sales engineer or representative will be glad to help you. If you don't have his name, consult your telephone directory—or write to . . .

EFFICIENCY — OVER 60 YEARS — RELIABILITY
BS&B
FURTHER EXAMPLE OF PRODUCT LEADERSHIP

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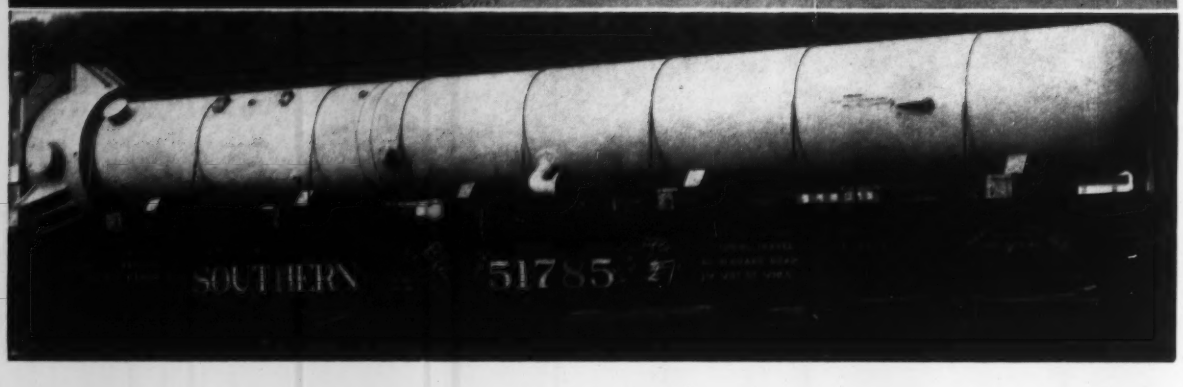
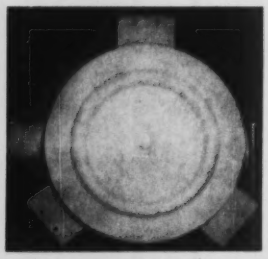
PROGRESS IN POWER through PROGRESS IN HEAT TRANSFER EQUIPMENT



Workman welding copper-nickel tubes to foot-thick steel tube sheet with 140-monel electrodes. Under destructive testing, rolled joints and tubes welded with cupro nickel rods leaked at elevated pressures, but tubes welded with 140-monel electrodes were leak-proof at 9600 psi



End view showing torus ring welded to channel and channel cover. Access to head is obtained by cutting ring with special tool; torus ring can be re-used. Conventional split key ring assembly taking the load on the cover is retained

FIRST ALL-WELDED FEEDWATER HEATERS

▶ A few years ago, an all-welded feedwater heater for 3600 psi and 790F would have been called a fantastic dream.

Yet six all-welded feedwater heaters in this pressure-temperature range are now proving their worth in the Linden, N. J., Generating Station of the Public Service Electric and Gas Company. Designed and manufactured by the Yuba Heat Transfer Division, formerly the Heat Exchanger Division of The Lummus Co., these heaters represent one of the many "firsts" contributed by this organization to the progress of the power industry.

In the heater shown above, two 50-inch-diameter cylinder sections of 1⅛-inch carbon steel were welded together. The open ends of the U-bends are welded, not roller-expanded, into the tube sheet (see upper small photo). Heads are sealed by a steel torus ring welded to channel cover and channel (see lower small photo).

The all-welded design minimizes the leakage which occurs in the conventional bolted and gasketed construction under high temperatures and pressures. Results are reduced maintenance and downtime.

This all-welded construction has been so successful it is certain to be specified for practically all future installations. Yuba engineers would be pleased to work with you. Call on them.

YUBA

CONSOLIDATED INDUSTRIES, INC.

Other Divisions Manufacturing Heat Transfer Equipment
California Steel Products Division, Richmond, Cal.
Adsco Division, Buffalo, N. Y.

YUBA HEAT TRANSFER DIVISION
HONESDALE, PENNSYLVANIA
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STEAM SURFACE CONDENSERS • EVAPORATORS
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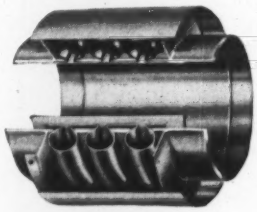
FEEDWATER HEATERS • BAROMETRIC CONDENSERS

NEW ZALLEA HyPTor* TOROIDAL EXPANSION JOINT



HyPTor corrugations have a circular or toroidal cross section which provides a lower operating stress at any given pressure than any other corrugation shape.

For unequalled endurance at pressure and temperature extremes

This unique toroidal expansion joint with thin-walled bellows is setting new performance and durability records in high pressure, high temperature service. It was developed to meet the severest operating conditions without sacrificing long life.

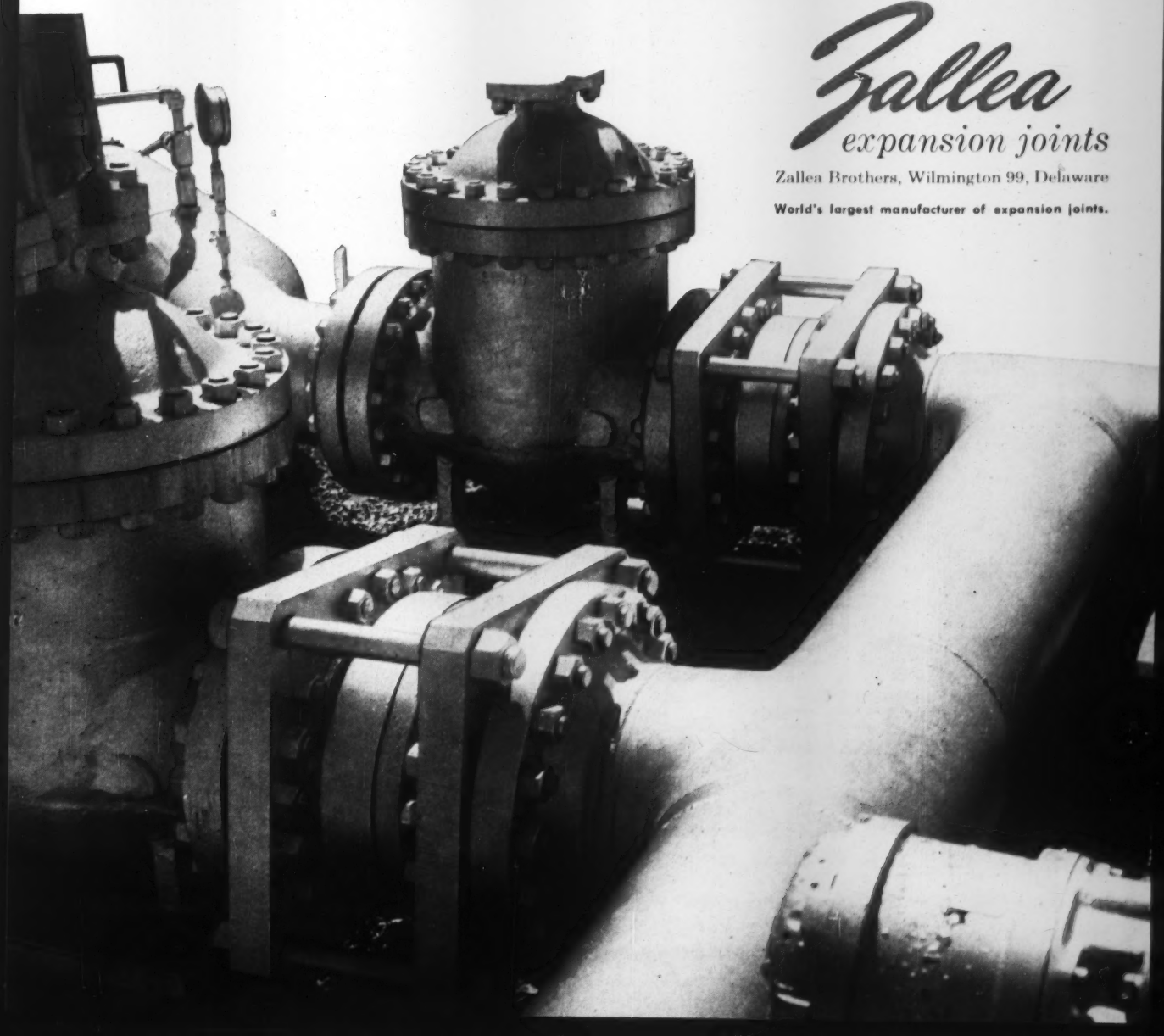
Minimum stress at high pressures is one advantage of the Zallea HyPTor. This is due to the thin-walled bellows and toroidal corrugations. Thin walls develop lowest flexing stress. The toroidal cross section assures lower operating stress at any pressure.

Superior performance at high temperatures. The toroidal corrugation of the HyPTor makes it suitable for use at high temperatures. Also, the HyPTor is hydraulically formed and free from circumferential welds which would act as stress raisers.

Longer life on the job. The ability of the HyPTor to absorb punishment without ill effects has been proved in service. A number of HyPTor Expansion Joints designed for 700 psi working pressure, were installed in liquid oxygen service in 1948. They are still operating . . . at pressures up to 2300 psi.

Get the complete story of the new Zallea HyPTor Expansion Joints. Our new 72-page Expansion Joint Manual gives full details—plus worthwhile information on basic types, design and installation data, expansion joint selection and recommended specifications. Write on your Company letterhead, for your free copy of Catalog 56, Zallea Brothers, 820 Locust Street, Wilmington 99, Delaware.

*Patented



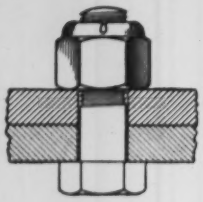
Zallea
expansion joints

Zallea Brothers, Wilmington 99, Delaware

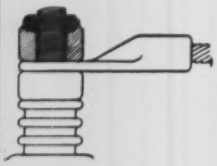
World's largest manufacturer of expansion joints.

Ten fastening problems solved by ELASTIC STOP nuts

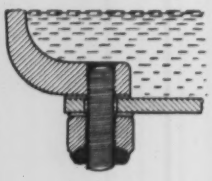
TIGHTENED AGAINST THE WORK



Vibration and impact proof bolted connections in standard applications.

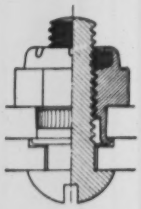


On all electrical terminals subjected to vibration in transit or operation, and for any electrical or electronic assembly where positive contact must be maintained.

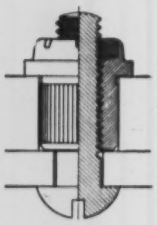


To seal bolt threads where leakage past stud threads must be prevented.

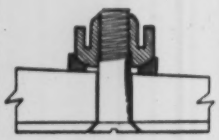
FOR MANY SPECIAL FUNCTIONS



Blind fastening applications where nut is "clinched" into sheet metal . . . becoming self-retaining as well as self-locking.

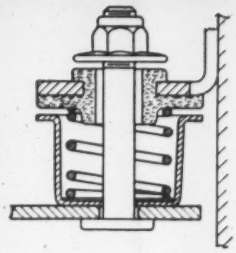


To eliminate drilling and tapping and provide steel thread strength for soft metals, an ESNA spline nut is pressed into a bored hole in casting.

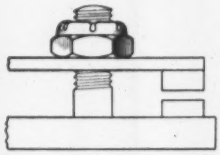


Simplified self-aligning self-locking fastener for bolting two non-parallel surfaces.

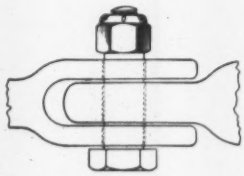
LOCKED ANYWHERE ON THE BOLT



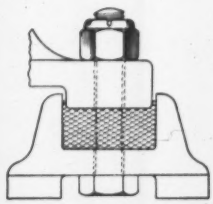
Spring-mounted connections or dynamic balancing, where nut must stay put yet be easily adjusted. (Flanged face eliminates need for extra washers.)



On make and break adjustment studs where accurate contact gaps must be maintained. Note "thin" height design for limited clearance.



For bolted connections requiring predetermined play.



For rubber-insulated and cushion mountings where the nut must not work up or down.

HOW THESE NUTS SOLVE SO MANY FASTENING PROBLEMS, ELIMINATING EXTRA PARTS AND OPERATIONS...

The red locking collar of an ELASTIC STOP® nut grips bolt threads with a perfect fit that will not loosen under severe vibration or stress reversals, and seals against liquid seepage. By bringing nut and bolt metal thread flanks into firm contact it eliminates wear producing axial play. The elastic locking action of the insert-type stop nut does not distort or gall bolt threads. It is reusable many times.

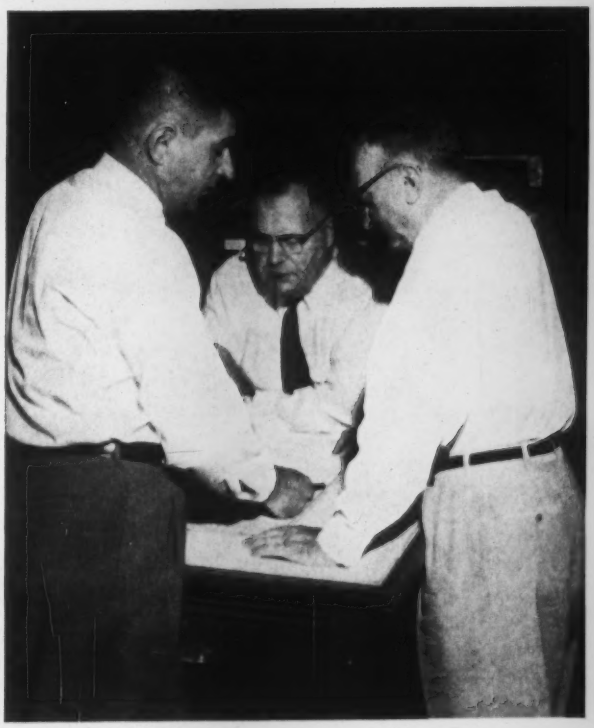
Send for the following free information: Elastic Stop nut bulletin; Rollpin® bulletin. Or enclose a drawing of your product for specific self-locking fastener recommendations. Write to Dept. N30-1111.

ESNA

ELASTIC STOP NUT CORPORATION OF AMERICA
2330 VAUXHALL ROAD, UNION, NEW JERSEY

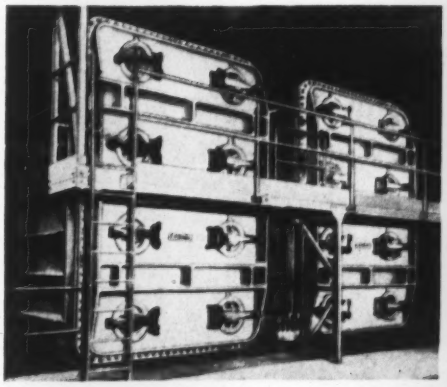
Before you place your next order...

It's saved many weeks, even months of engineering and executive time for scores of power companies! Basically, the idea is to shift as much of the work load as possible from the customer to C.H. Wheeler. By working this way, long conferences are replaced by short phone calls, and lengthy customer-prepared engineering specifications are supplanted by thumbnail performance sheets.

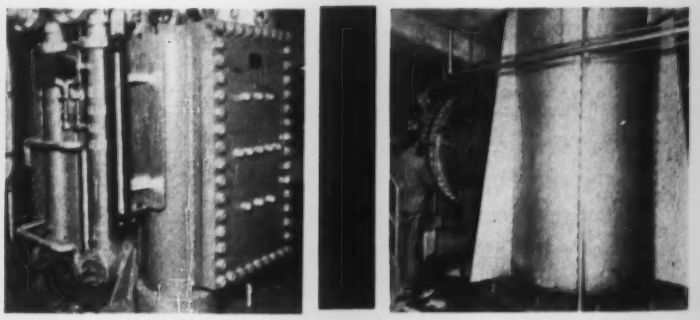


Since Wheeler specializes in designing and building condensing equipment, its Engineering Department is set up to take this bare minimum of data from the customer, and work up a comprehensive proposal from it alone. Here you see several department heads of C. H. Wheeler discussing engineering design prior to preparing a proposal for a C. H. Wheeler client.

Discover C. H. Wheeler's time-saving way to buy steam condensers



We often save clients up to 4 months' time by sending Wheeler engineers to work "on the board" at clients' offices, instead of mailing drawings for approval. Above is a typical installation—a 105,000 sq. ft. Dual Bank Divided Water Box Unit, installed at a New York station.* It condenses 950,000 lbs. steam/hr.



Other C. H. Wheeler power plant equipment includes steel-shell "Tubejet"® Air Ejectors (left) as installed at eastern plant*, Circulators (right) which in the same plant deliver 86,500 gpm water, and Condensate Pumps. See your representative or write for details on the time-saving way to buy Dual Bank Surface Condensers and other power equipment.

**Names of these and other power stations equipped by C.H. Wheeler supplied on request.*

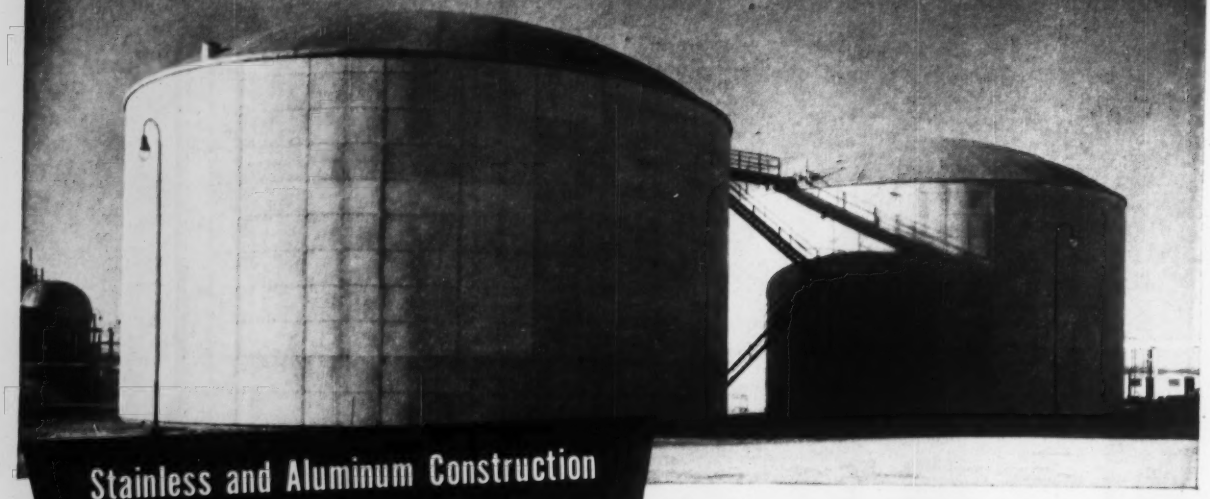
C. H. Wheeler Mfg. Co.

19TH & LEHIGH AVENUE Philadelphia 32, Pennsylvania

Steam Condensers • Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products

At SOHIO Petrochemical Plant:

CB&I-Built tanks store 83% ammonium nitrate

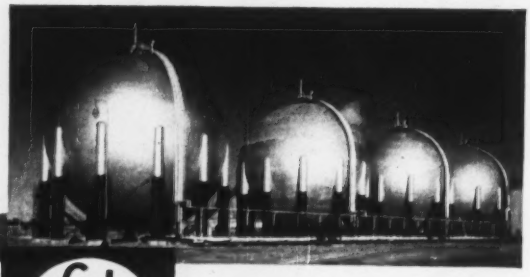


Stainless and Aluminum Construction extends useful life of storage structures for ammonia and derivatives

At Sohio Chemical's $17 million ammonia plant, near Lima, Ohio, extensive use was made of stainless steel and aluminum for tanks used to store the highly corrosive products of this new petrochemical operation.

Among other structures, CB&I designed, fabricated and erected the two 80-ft. diameter by 40-ft. high aluminum tanks shown above, built of Alcoa Aluminum. They are designed to hold 35,000 bbls. each of ammonium nitrate.

The handling of special metals, including design of structure, fabrication and erection, is a specialty—and an art with CB&I. Our plants are staffed, experienced and equipped to handle special alloys and to fabricate from a variety of cladding materials. Included is Hortonclad®, produced by the CB&I high-strength, vacuum-bonding process. Write our nearest office for further details.



OTHER CB&I STRUCTURES at Lima plant include a 30-foot diam. 304ELC solid-stainless tank for nitric acid storage, A545 aluminum drums for ammonium nitrate solution and the four 20,000 barrel Hortonspheres® above.

Chicago Bridge & Iron Company

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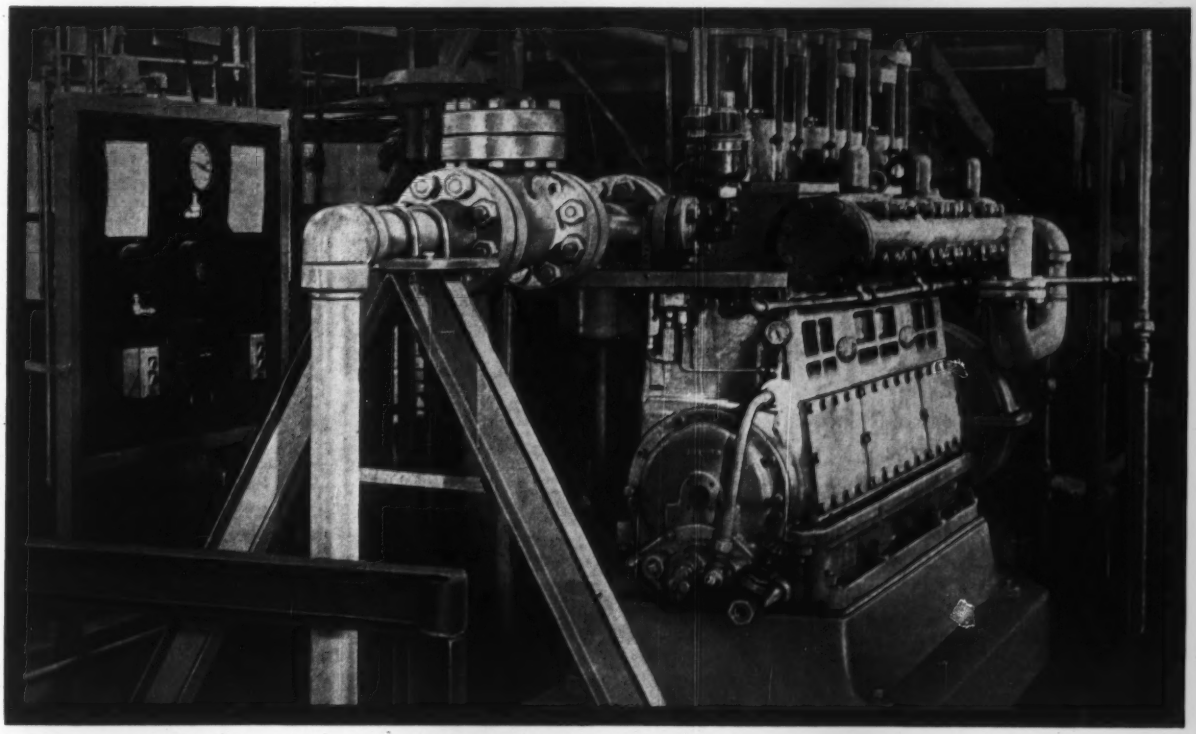
C-36

MIDWESTERN DIE CASTER FINDS ANSWER:

How to pump hydraulic fluids non-stop when downtime means loss of production

During "rush seasons," when shifts work around the clock, this large midwestern manufacturer must have constant, dependable hydraulic power. One hundred percent capacity can only be maintained when the hydraulic system delivers a steady output pressure with no downtime.



How the problem was solved: Foreseeing 24 hour days, seven days a week, the die caster turned to Aldrich. As new facilities were added, so were Aldrich Pumps. The first, a 250 gpm pump, was installed four years ago. Since then, three more 207 gpm pumps have been added. All are $2\frac{1}{4}$" x 5", 1500 psi, gear driven Aldrich Septuplex Pumps, equipped with 200 hp motors.

Result: Just what you'd expect of an Aldrich Installation—steady dependability for continuous operation—highest reliability for intermittent service. Maintenance is held to a minimum. Operating efficiency has remained constantly high. Get full information on Aldrich Pumps and their advantages. Write the Aldrich Pump Company, 29 Pine St., Allentown, Pa.

the toughest pumping problems go to ALDRICH

NOW!

A BRAND-NEW CONCEPT IN FLOW TOTALIZING!

. . . THE NEW FOXBORO PNEUMATIC FLYBALL INTEGRATOR

Inherently Accurate!

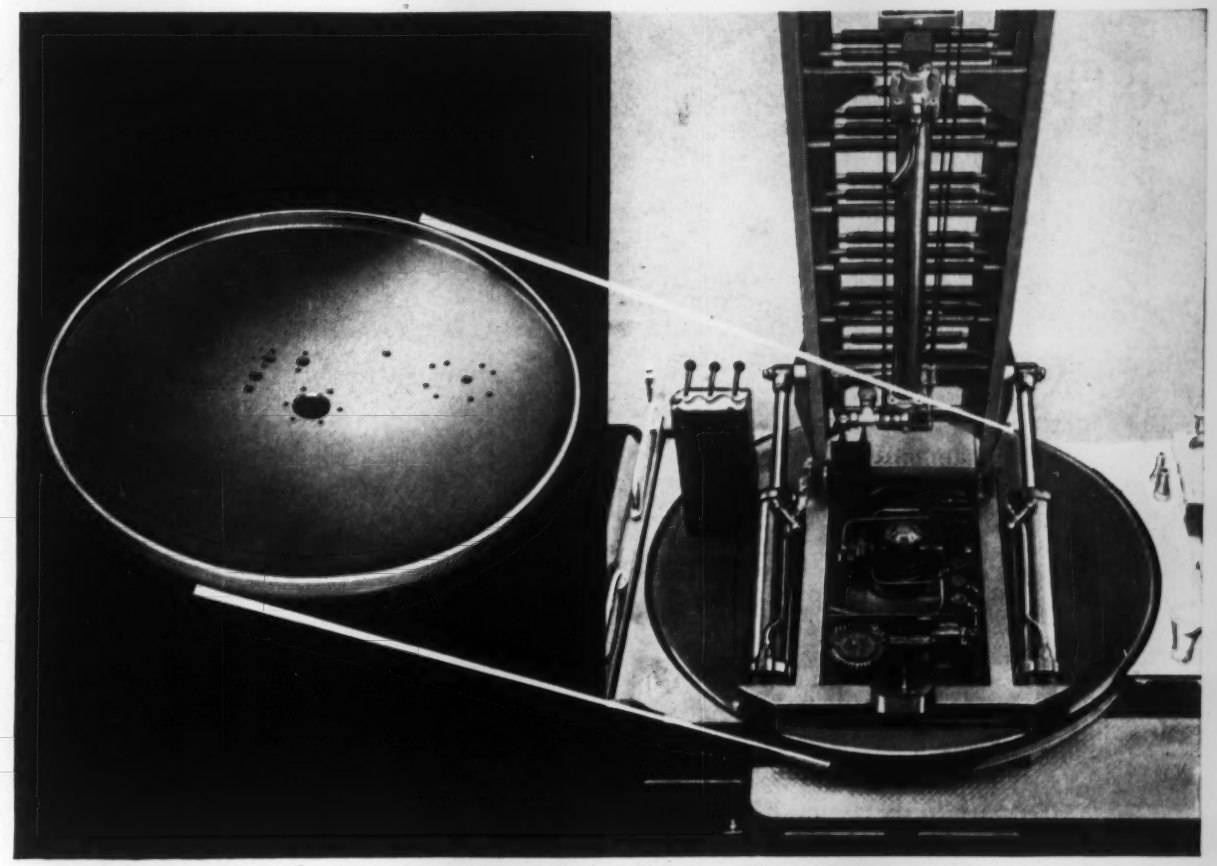
- Eliminates Inaccurate "Spot Check" Counting!
  Continuous integration assures highest precision.
- Eliminates Cam and Linkage Errors!
  Unique design balances differential pressure signal directly against centrifugal force.
- Eliminates Calculations!
  Automatically extracts square root — shows totals in desired units.
- Eliminates Fire and Explosion Hazards!
  Simple, all-pneumatic operation requires no electric motors, wires, or contacts.

FOXBORO
REG. U.S. PAT. OFF.

Now you can integrate the flow of all process fluids or plant services *continuously* . . . with new accuracy . . . complete safety! The all-pneumatic Foxboro Flyball Integrator completely eliminates intermittent counting and fire hazard. Its simple, force-balance operation utilizes the 3-15 psi air signal from any conventional differential-pressure flow transmitter. This signal is *continuously* balanced against the "flyball" force of the instrument's pneumatically-driven turbine. The square root function is automatically extracted . . . you read flow totals *directly*.

The Flyball Integrator mounts at the point of measurement or on a panel hundreds of feet away. Response and accuracy are completely unaffected by ambient temperature changes or pressure changes in turbine air supply. Ideal solution to all plant fluids accounting and in-process inventory checking. Write for complete details. The Foxboro Company, 9611 Neponset Ave., Foxboro, Mass.

FIRST IN FLOW



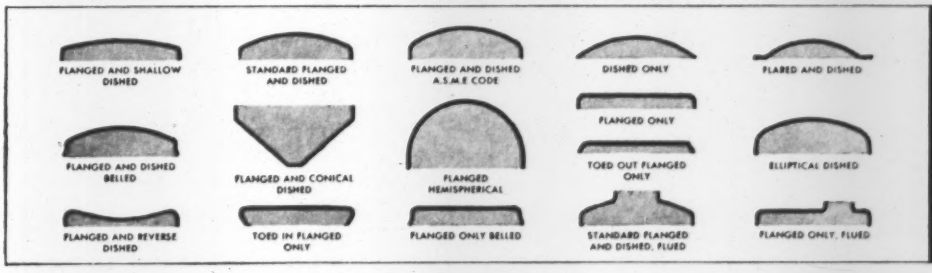
Aerial ladder builder finds notable benefits in designing turntables with Lukens steel heads.

You too can simplify, strengthen...and save... designing with Lukens heads

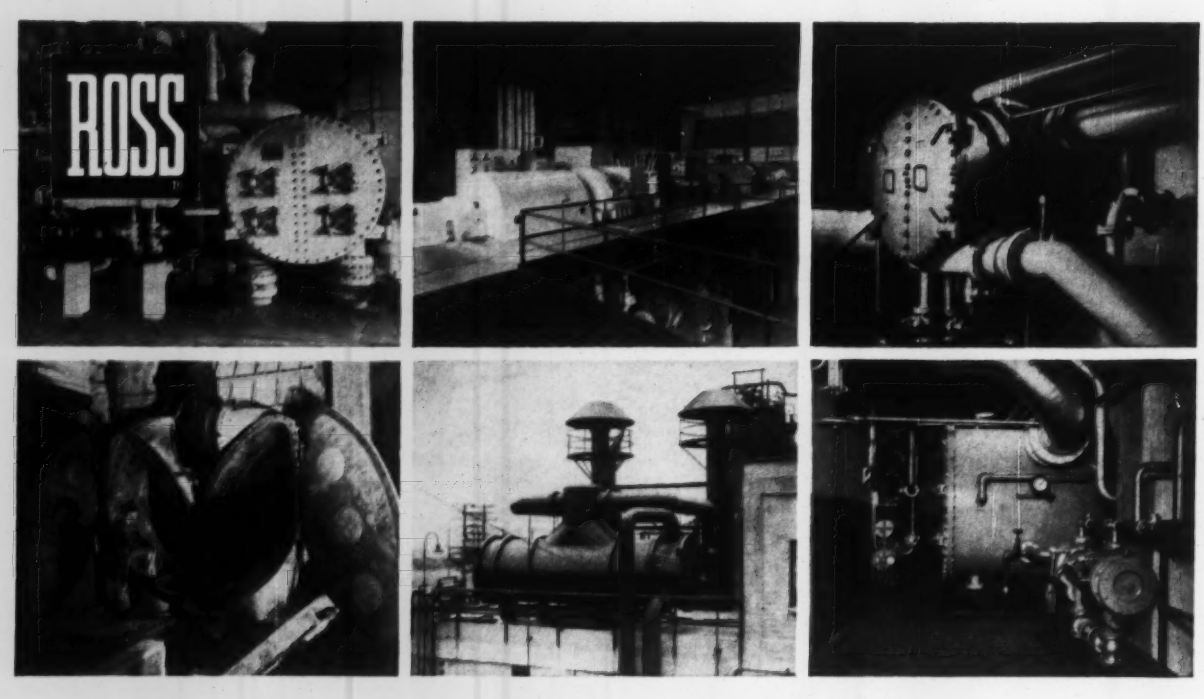
■ Imagination really paid off for Maxim Motor Company of Middleboro, Mass., producers of aerial ladders for fire-fighting equipment. Using a tough, one-piece Lukens standard flanged head as the ladder turntable, Maxim eliminated fabricating steps and materially lowered costs. The hydraulic mechanism was easily top-mounted for accessibility and ready maintenance.

If you build heavy or light machinery, valves, wheels—even fire engines—imaginative use of Lukens heads may improve your equipment and save you money. Lukens' fifty-five years as the leading producer of spun and pressed steel heads for many applications are at your service. Write for Catalog 932, *"Pricing and Engineering Data."* Lukens Steel Company, Coatesville, Pa.

Lukens Offers the World's Broadest Line of Spun and Pressed Heads of Carbon, Alloy and Clad Steels



LUKENS (R)



On the subject of Surface Condensers

ROSS speaks with 40 years' experience

What are *your* requirements in surface condensers? A single unit or several? Large twin-bank or smaller single-bank type? *Ross is singularly equipped to fill your needs.*

Long a leading producer of all types of heat exchange equipment and condensers, Ross has wide and diversified experience in serving power plants. Starting with the Pearl Harbor Navy Yard installation in 1917, it has continually stressed progressive engineering that has set the pace with many "firsts" in surface condenser design.

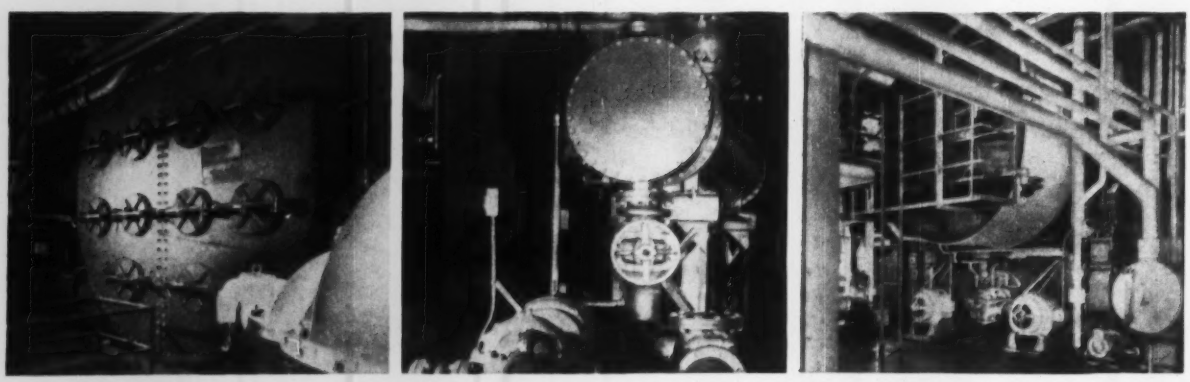
For 40 years, utilities, institutions, office buildings and industries have presented many unique problems to Ross . . . *and found their solution.* Today, Ross has design precedents for virtually every condenser application.

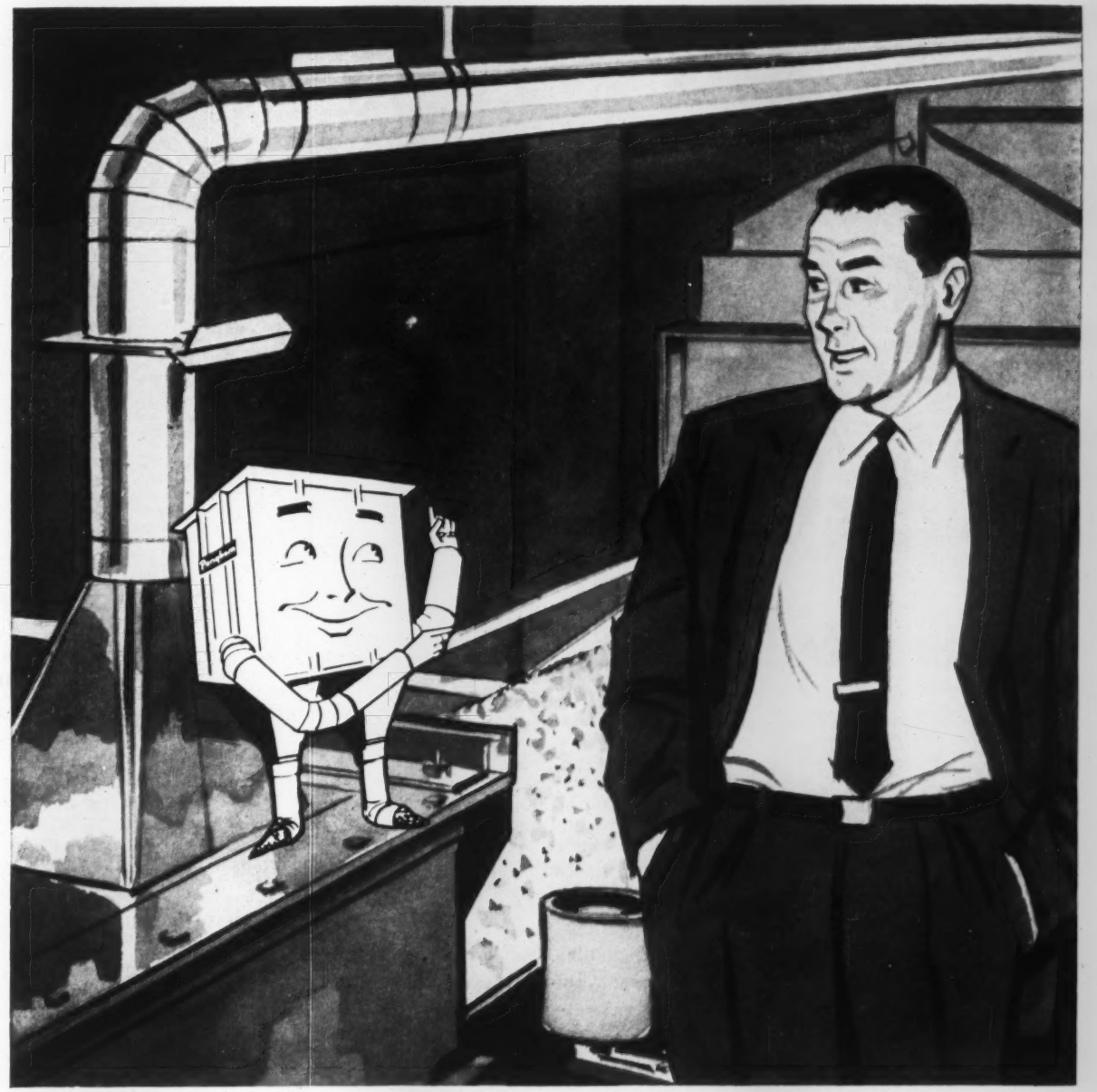
Put this exceptional Ross engineering talent to work for you on *all* your condenser and heat exchanger requirements for power generation. With sales engineering facilities in principal cities, and representatives throughout the nation and abroad, Ross can provide prompt, on-the-spot service anywhere.

Pertinent facts on Ross leadership in surface condenser design are available in Bulletins 8.1K1 and 8.2K1. Write for your copies. Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

ROSS HEAT EXCHANGER

Division of AMERICAN-Standard





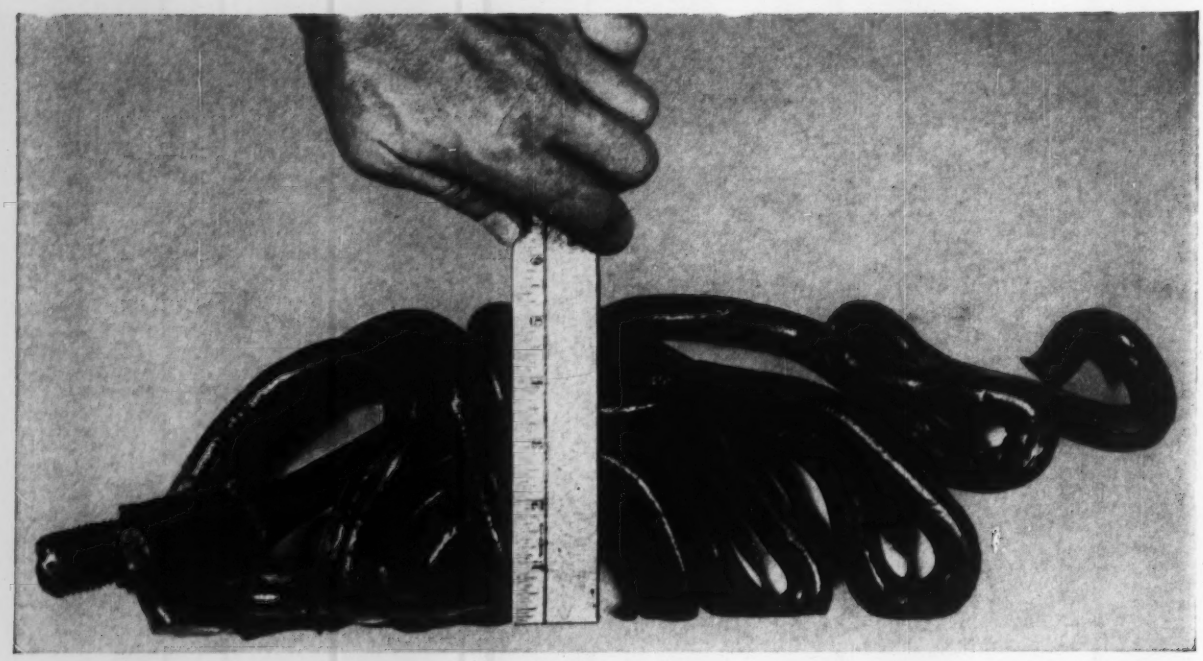
"What? A 15% increase in production machinery life?"

Yes, Pangborn Dust Control can increase your machinery life up to 15% or more! Pangborn Dust Collectors trap dust controlled at the source to prevent the abrasive wear and tear of uncontrolled dust settling in valuable equipment. Pangborn Dust Control can save you thousands of dollars by substantially lengthening the life expectancy of your machinery.

What's more, Pangborn gives you other benefits of lower housekeeping costs, higher employee efficiency, extra profits from any salvage value and better employee and community relations. And Pangborn offers a complete line of collectors, dry and *wet*, for all jobs.

Why not discover how you can profit from Pangborn Dust Control? Write for Bulletin 922 to: PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control & Blast Cleaning Equipment.*

Pangborn CONTROLS DUST



This steel "pretzel" was 14 feet long!

Down near Caprock, New Mexico, they're still talking about it . . . the nickel alloy steel sucker rod that squashed into 18 inches.

It took an accident to demonstrate real toughness.

The sucker rod, a long shaft connecting power at the surface with a piston thousands of feet below, was operating rhythmically. Its reciprocal motion brought up oil in rich spurts.

Suddenly, part way down, the well casing broke, trapping the sucker rod. Fourteen feet of rod were quickly crammed into 18 inches. But despite violent twists the sucker rod *didn't break!* See for yourself!

Nickel alloy steel provides toughness... plus fatigue resistance

Stresses on sucker rods from the pumping motion are high, and fatigue life must be extended as far as possible even in corrosive wells. That's why this one was made of AISI 4820 steel – a high-strength nickel alloy steel containing 3.5% nickel and .25% molybdenum.

It's a quenched and tempered steel. Normally a carburizing grade, 4820 specially quenched and tempered gives excellent toughness along with through hardness and relatively high strength.

Typical mechanical properties are:

Ultimate strength	120,000 psi
Yield strength	110,000 psi
Elongation	25% in 4 x diam.
Reduction of area	68%
Brinell hardness	241
Izod impact	90 ft. lbs.

We don't know of many better illustrations of the toughness and ductility of high strength nickel alloy steels than this one.

At any rate, down near Caprock, New Mexico, they're still talking about it.

If you'd like to know more about high mechanical properties of Nickel Alloys Steels . . . their strength, toughness, ductility and resistance to corrosion fatigue, for example, send for "The Properties of Heat Treated Wrought Nickel Alloy Steels."

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street New York 5, N. Y.

INCO NICKEL

NICKEL ALLOYS PERFORM BETTER LONGER

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NOVEMBER 1957

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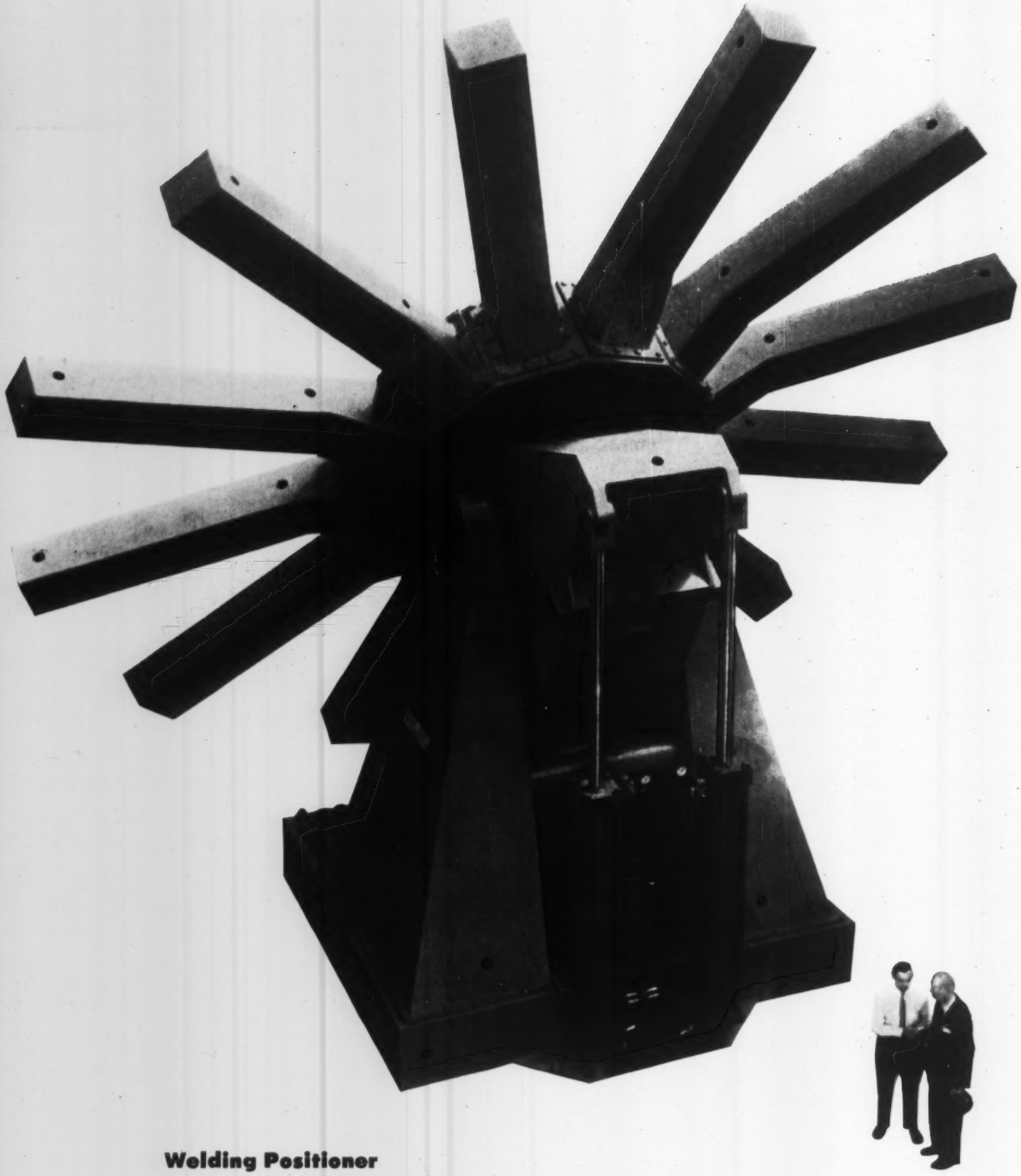

Welding Positioner

Weighing 100 tons, this welding positioner has an over-all height of 20 ft 10 in. It will be used for holding extremely large units in place while they are welded automatically. The rimless-spoked-wheel-like 33-ft-diam table can be tilted up to 60 deg. A 2-hp motor for slow forward and reverse speeds operating at 0.005 to 0.05 rpm takes 3 hr to complete a revolution of the table. A $7\frac{1}{2}$-hp motor is used for more rapid traverse. The machine was designed for the Mare Island Naval Shipyard by the Pandjiris Weldment Company and manufactured by Bethlehem Pacific.

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NOVEMBER 1957

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George A. Stetson, *Editor Emeritus*
J. J. Jakiitsch, Jr., *Editor*

MECHANICAL ENGINEERING

Annual Meeting

This year's ASME Annual Meeting, to be held in New York, N. Y., December 1 to 6, will be the largest ever scheduled by the Society and is worthy of the attention of a large cross section of the membership. Every one of the Society's 23 Professional Divisions plus a host of special technical committees will participate in a program of some 140 sessions at which more than 250 papers will be presented. Besides affording mechanical engineers an opportunity to acquaint themselves with the latest technical developments in their own specialties, the meeting is designed to keep them posted in other areas of mechanical engineering as well.

A glance at the advance program, printed in the October issue of MECHANICAL ENGINEERING, offers ample evidence of the scope of the meeting. This program as printed, incidentally, departs from the usual day-by-day arrangement used in the past. Instead, the program is arranged by division or committee sessions so that members will be able to locate subjects of their interest more easily.

In addition, the social events—dinners, luncheons, inspection trips—are conducive to good fellowship. They provide the means for members—especially the younger ones—to make new acquaintances, discuss mutual problems, and compare notes. It has been found in many instances that the true benefits of attending a Society meeting of this size and importance generally occur "between sessions."

So, remember the Annual Meeting dates December 1-6 Hotels Statler and McAlpin in New York. This is your meeting, arranged by committees made up of your fellow members, to broaden the scope of your professional interest. It will be to your advantage to attend.

75 Years

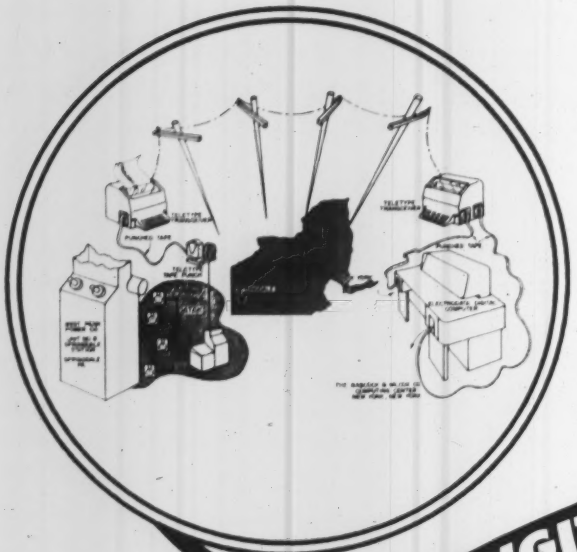
CONGRATULATIONS are in order for *Power* magazine on completing 75 years of editorial service for engineers. To commemorate the occasion, Editor L. N. Rowley and his staff have devoted the September issue of *Power* to mark the anniversary. Within its pages over 700 *Power* looks back at the past, takes stock of the present, and peers into the future of energy production.

The history of *Power* closely parallels the history of ASME—the former established in 1882 and the latter founded in 1880.

For example, Fred Low, who was president of ASME in 1924, served as editor of *Power* for 42 years from 1888 to 1930. During that period he laid the groundwork for the magazine's function: A practical service to the engineers who design, operate, and maintain power-service facilities throughout all industry. Mr. Low also figured prominently in other ASME activities, notably as chairman of the Boiler Code Committee and the Power Test Codes Committee.

Editor Rowley, who is now also publisher of *Power*, has been an active member of ASME since 1931 and, among other things, he has served on the ASME Publications Committee, the Board on Technology, the Finance Committee, and this year he has been nominated to serve as Director (Administrative) of ASME for a four-year term.

ASME, from its inception, therefore, has always had a genuine interest in the field through its Power and other related Divisions, and ASME members should find reading this *Power* issue worthwhile, interesting, and exciting.



The Application of Automatic DIGITAL-DATA-COLLECTING to Boiler Testing

A DESIRE to reduce the manpower and time required for field-test work on boilers motivated an investigation of some of the possibilities of automatic data-taking. A joint program was undertaken in the summer of 1955 by The Babcock & Wilcox Company and the Bailey Meter Company.

Equipment was visualized which could be installed readily in a power station, and operated by a crew of two or three men. The data output would be in a form ready for transmission to a remote computer by teletype, to reduce the elapsed time between testing and obtaining computed results.

DATAK, an assemblage of automatic data-gathering equipment, built as part of this program, was installed on a boiler at Springdale, near Pittsburgh, Pa., and teletype communication established with a computer in New York. Data taken in Springdale were transmitted to New York, fed into the computer, and the results transmitted back to Springdale in less than an hour from the start of the test.

Rapid return of calculated results to the test site hinges on being able to schedule computer time to correspond with the test schedule. This problem may be quite formidable if the test work is competing with accounting, production, or engineering work for computer time.

The real objective of the installation at Springdale was not to prove that data could be transmitted by teletype, or that calculations could be performed on a digital computer, but rather to gain experience with the data-collecting equipment.

The early removal of the DATAK equipment from Springdale, for use at another site, limited the study program to establishing the reliability of the equipment and gaining some operating experience. The logic of the system proved sound, the consistency of the results potentially satisfactory, and the manpower savings large.

The sequence of operation of the various units comprising DATAK is controlled by a "ring counter" called the sequencer. The basic timing means for the sequencer and consequently the rest of the system consists of a set of electrical contacts mounted in the perforator and arranged to close and open once for each revolution of the perforator shaft.

The DATAK Equipment

The first DATAK system built had a capacity of 149 data points—120 for thermocouples, 20 for flow, pressure, draft, and so on, and 9 for oxygen analysis. All the data points except those for oxygen analysis are interrogated, and the numerical values punched in teletype tape in about 100 sec; the nine oxygen samples require 12 min for reading. Thus a complete data run requires 13 min and 40 sec. An oxygen sample-tube-cleaning operation prevents repeating the oxygen analysis within 10 min, but this does not interfere with repeating the taking of temperature, pressure, flow, and draft data.

The basic building block of the system is a device called an analog scanner which consists of a stepping switch, a standard self-balancing potentiometer, and a retransmitting slidewire. Its function is to convert the primary element or transducer signal to a standard analog signal representing the value of the measured variable. In the system being described, an analog scanner can be connected to any one of 20 thermocouples or transducers

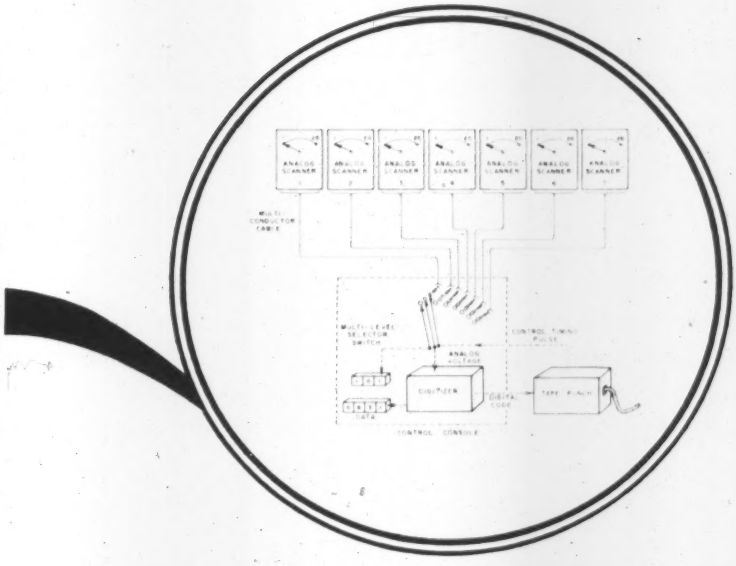
[1] Instrument and control engineer, West Penn Power Company, Cabin Hill, Greensburg, Pa.

[2] Analytical research engineer, The Babcock & Wilcox Company, Research Center, Alliance, Ohio. Assoc. Mem. ASME.

[3] Assistant staff engineer, Bailey Meter Company, Cleveland, Ohio.

[4] Electrical engineer, The Babcock & Wilcox Company, Research Center, Alliance, Ohio.

Based on two papers, "An Automatic Digital-Data-Collecting System for Use in Central Stations," by W. T. Hage and H. T. Hoffman, ASME Paper No. 57—SA-58; and "A Discussion of an Application of Automatic Digital-Data-Collecting System to Boiler Testing," by J. H. Bail, C. E. Jones, and H. T. Hoffman, ASME Paper No. 57—SA-61; contributed by the Power Division and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9–13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.



By J. H. Bail,[1] C. E. Jones,[2] H. T. Hoffman,[3] and W. T. Hage[4]

The exploration of the new possibilities for boiler and turbine studies has hardly kept pace with the development of automatic digital-data-collecting equipment, and yet here lies the possibility for a significant contribution to the field of electric power generation. The industry has reached a point of diminishing returns in increasing the initial conditions of temperature and pressure. The possibility is that equipment like DATAK, continuously coupled to a computer, monitoring the performance of a large unit may narrow the gap between the design heat rate and that generally achieved in operation.

Fig. 1 The data for the first position on each analog scanner are digitized and punched into the tape, then repeat the cycle for the number two positions on each analog scanner, until all of the readings have been taken. An analog scanner can be connected to any one of 20 thermocouples or transducers through its stepping switch. The servomechanisms require a maximum of 5 sec to balance setting, a minimum scan time per level of 5 sec. The total time to punch the 20 levels is 100 sec.

through its stepping switch. Temperatures, pressures, flows, and so on, may be intermixed on any given scanner. These analog scanners, which are connected to the control console by a flexible cable, may be located anywhere throughout the boiler convenient to the points to be measured. The object of this arrangement is to minimize the amount of special wiring required for each new installation.

The system output is paper tape, punched in teletype code containing the desired data. This tape also contains certain computer commands, date, time, and test number, and is used to transmit the data to the computer via teletype.

DATAK uses its own thermocouples and other transducers, thus not interfering with the normal operation of the boiler. This procedure allows transducer ranges to be set at optimum values for the test rather than accepting the limitations imposed by operating requirements.

The apparatus shown in Figs. 1 and 2 constitute the complete 140-point data-taking system. The four analog-scanner housings shown on the right and left side of Fig. 2 were placed at locations around the boiler convenient to the 20 data points each was to service. Two of these housings each contained two analog scanners; the remaining two contained one scanner each. The oxygen-analysis analog scanner is not shown in this picture.

The digitizer, center left; control console, center right; and the perforator shown on top of the control console, were located in an office together with the teletype equipment which transmitted to the New York office the information stored on the perforated tape.

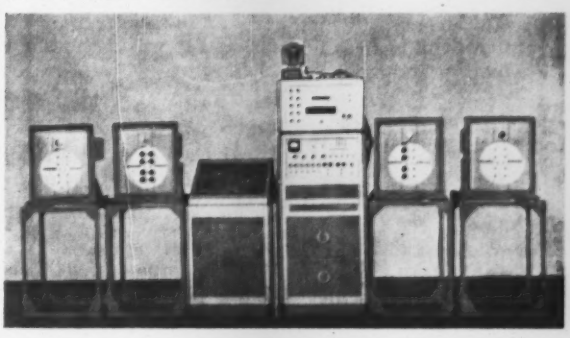
System Logic

Fig. 3 shows the schematic arrangement of the entire system. The signal from one transducer at a time flows to the analog unit where it is converted to a slide-wire position and retransmitted as a percentage of the total resistance. It next flows to the digitizer where it is converted to a four-digit number, this number being the data value. The four digits of the data value are then loaded, simultaneously, into the four memory cells, releasing the digitizer to work on the next data value. The four digits are converted within the memory to teletype code and sequentially read into the perforator where they are punched, in code, in the tape.

The sequencer, synchronized by the perforator, performs the function of stepping the analog scanners, resetting the digitizer, loading and dumping the memory units, and sequentially reading out the loaded memories at the proper time and in the proper sequence.

The logic unit dictates the format of the tape words and permits nondata information to be entered in the tape. This information, which is not normally converted to teletype code in the memory units, is so converted in a special matrix.

Fig. 2 The units of the complete 140-point data-taking system include the four analog scanners on the left and right, and the digitizer and logic unit in the center, which together constitute the control console



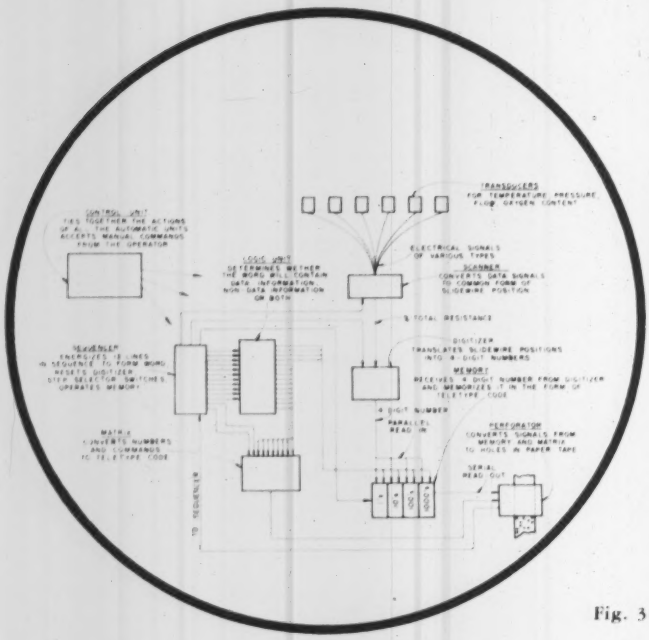


Fig. 3 Schematic arrangement of the entire DATAK system

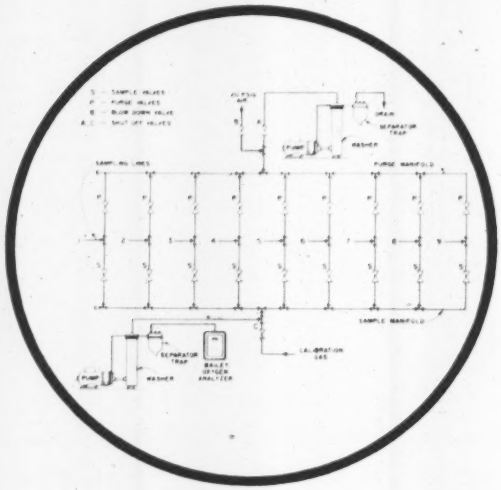


Fig. 4 A single Bailey oxygen analyzer is used to analyze sequentially 9 flue-gas samples and two samples of bottled gas

The block shown as the control unit represents the control panels on which all manual controls and visual indicators are located. From these panels, the operator controls the functioning of the entire system.

The Analog Scanner

The function of the analog scanner is to convert the thermocouple millivolts, pressure-transducer output, and the like, to a standardized analog signal for conversion to digital code. Basically, this unit consists of a stepping switch to select the 20 inputs one at a time and a servomechanism to convert the input to a shaft position. The standardized analog output is the position of the slider of a potentiometer mounted on the shaft.

The servomechanism, its associated electronics, and the measuring-circuit components are all commercial items manufactured by the Bailey Meter Company.

Each analog scanner has provision for the installation of 6 hand-adjusted resistors (hand-set potentiometers) which are used to insert into the data-gathering system those items of data not readily measured automatically. These include such items as the heat content of the fuel, the ultimate or proximate analysis of the fuel, unburned combustible refuse, megawatt generation, and so on. These potentiometers are interrogated by the data-point selector switch in the same manner as a data point. Temperatures are measured in units of millivolts, pressure in psi, draft in inches of water, and flows in thousands of pounds per hour.

The Oxygen Analyzer

A single Bailey oxygen analyzer is used in conjunction with a step switch and a series of electric-pilot pneumatically operated valves to analyze sequentially nine flue-gas samples and two samples of bottled gas. This is shown schematically in Fig. 4.

At the start of the cycle, all of the purge valves P open and a gas flow is established in all nine sample lines.

A gas-analysis cycle requires a 1-min purge period after all purge valves P have been opened to the purge header. Then the valve C which is connected to the calibrating gas tank is opened and the calibrating gas is analyzed. After 1 min, the analysis value is transmitted to the logic and control unit where it is punched on tape and the calibration gas valve is closed. Next, the sample valve S is opened and the purge valve closed on sampling line 1. After 1 min, the analysis of the first sample is transmitted to the logic and control unit, the sample valve is closed, and the purge valve opened. The same procedure is followed to analyze the remaining eight gas samples. Then a final calibration is made and the analyzer goes into the blowdown phase of the cycle.

At the beginning of the blowdown cycle all S valves and the A valve are closed and the B valve is opened to introduce 20-psi air into the purge manifold. The P valves are opened sequentially for 1 min to blow out each sample line. If any line is plugged, the action of the overpressure switch lights a warning light and stops the blowdown.

The Installation

This first model of DATAK was in service on a central-station boiler for about 6 weeks and satisfactorily met the original specifications of portability, data-point flexibility, simplicity of operation, and compatibility with the Electro Data Computer, DATATRON. The reliability of the system is excellent. Though the system contains some 200 relays, no relay or control failure was experienced in this period. This system is not presented as an example of the application of the latest techniques for automatic digital-data collecting. Rather, it represents a straightforward approach using components with well-established characteristics and reliability. This permitted attention to be given directly to the development of system logic and the study of the application of this type of equipment to boiler testing.

The installation was completed and debugged by Aug. 22, 1956, and removed on Sept. 17, 1956. In the interim, 322 test runs were made without equipment failure.

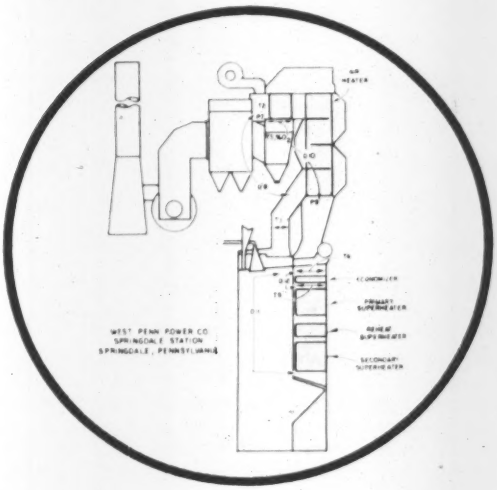


Fig. 5 The location on the boiler of the points of measurement listed in Table 1

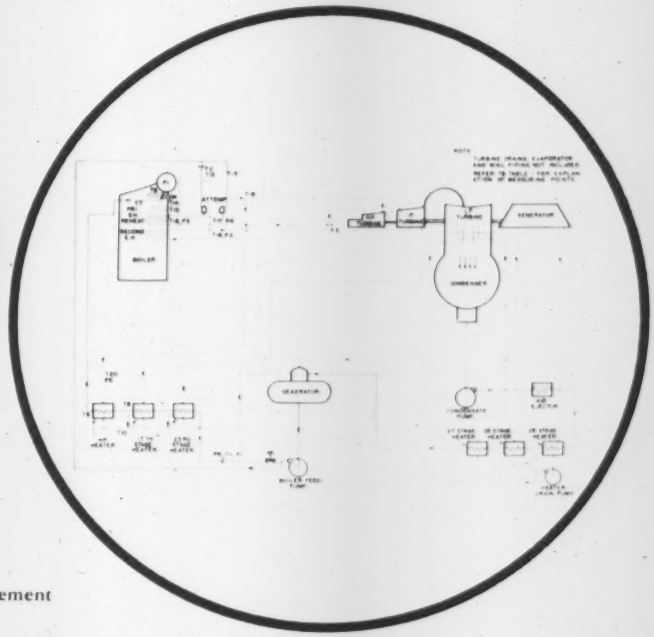


Fig. 6 Location on the fluid cycle of the points of measurement listed in Table 1

DATAK was operated by a two-man crew although there usually were more people on the job in order that as many as possible might gain experience.

The boiler was instrumented to allow the calculation of boiler efficiency, the heat absorbed in each part of the convection pass, the gas temperature entering and leaving each section of the convection pass, and the over-all conductance of each major section of the convection pass.

Table 1 lists the data points, and Figs. 5 and 6 show their location on the boiler and the fluid cycle, respectively.

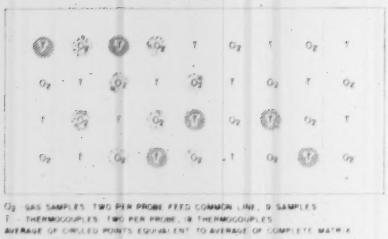
The proper location of the points of measurement for boiler testing must always be considered carefully. The most difficult choice is probably that of thermocouple and gas-sampling locations for determining flue-gas temperatures and oxygen content. In this installation a geometric matrix of thermocouples and gas-sampling probes was installed in the flue-gas duct. In the calculations, an arithmetic average of the matrix readings was used as the value of temperature or per cent O_2.

The installation of thermocouples in the gas stream in a manner similar to the one used during this program can have two purposes. One purpose is to determine local values of gas temperature, the other is to determine an average value of the gas temperature.

If the object of the measurement is to study contours and how they change with operating conditions, then a large matrix with a fine mesh is required. The matrix used at Springdale was not large enough to accomplish this purpose adequately. However, the ability to increase the size of this system is sufficiently obvious so as not to require proof. The determination of an average value for gas temperature normally would require a matrix with a much coarser mesh than the one used but which would still result in substantially the same average value. Fig. 7 shows the configuration of the flue-gas composition and temperature-sampling matrices used at the air-heater outlet. The average of the circled points will give an answer essentially the same as the average of each of the matrices. These fewer points may be

Table 1 DATAK Data Points

Temperatures		
T 1	Air-heater air outlet	12 I.C. thermocouples
T 2	Air-heater air inlet	2 I.C. thermocouples
T 3	Air-heater gas outlet	18 I.C. thermocouples
T 4	Economizer gas outlet	18 I.C. thermocouples
T 5	Economizer gas inlet	18 I.C. thermocouples
T 6	Economizer water outlet	
T 7	Economizer water inlet	
T 8	High-pressure-heater water inlet	
T 9	High-pressure-heater water outlet	
T10	High-pressure-heater drain	
T11	Feedwater at flow nozzle	
T12	Superheater attemperating water	
T13	Reheat attemperating water	One iron-constantan thermocouple at each location
T14	Superheater attemperator steam inlet	
T15	Superheater attemperator steam outlet	
T16	Secondary superheater steam outlet	
T17	Reheater steam outlet	
T18	Reheater attemperator outlet steam	
T19	Reheater attemperator inlet steam	
T20	High-pressure-heater steam	
T21	Gas temperature between secondary superheater and reheat superheater	3 chromel-alumel thermocouples
Pressure, Draft, Differential		
P 1	Drum	
P 2	Superheater outlet	
P 3	Reheater inlet	
P 4	Reheater outlet	
P 5	High-pressure-heater steam	
P 6	Feedwater	
P 7	Air-heater air inlet	
D 8	Air-heater air differential	
P 9	Air-heater gas inlet	
D10	Air-heater gas differential	
D11	Convection-pass differential	
D12	Economizer gas differential	
Flow		
F1	Feedwater	
F2	Superheater attemperator	
F3	Steam flow	
F4	Air flow	
Gas Samples		
1	Per cent O_2 at air-heater outlet (9 points)	



O_2 GAS SAMPLES, TWO PER PROBE FEED COMMON LINE, 9 SAMPLES
T THERMOCOUPLES, TWO PER PROBE, 18 THERMOCOUPLES
AVERAGE OF CIRCLED POINTS EQUIVALENT TO AVERAGE OF COMPLETE MATRIX

Fig. 7 The configuration of the flue-gas composition and temperature - sampling matrices used at the air-heater outlet

Table 2 Repeatability of Data

Scanner Measuring Circuit Items

All gas, air, and water temperatures, deg F	0.4
All steam temperatures, deg F	0.6
Drum and superheater outlet pressure, psi	1.0
Extraction steam, reheater in and out pressure, psi	0.4
Feedwater pressure, psi	2.0
Feedwater flow, lb per hr	1200
O_2 analysis, per cent O_2	0.05

Hand-set items: repeatability given in units of parameter

Moisture in air	0.024 lb H_2O per lb dry air
Unaccounted losses, etc.	0.024 per cent efficiency
Radiation loss	0.0024 per cent efficiency
Per cent carbon in fuel	0.05 per cent analysis
Per cent H_2 in fuel	0.05 per cent analysis
Per cent O_2 in fuel	0.05 per cent analysis
Per cent S in fuel	0.05 per cent analysis
Per cent ash in fuel	0.05 per cent analysis
Per cent H_2O in fuel	0.05 per cent analysis
Higher heating valve	50.00 Btu per lb
Per cent carbon in ash	0.05 per cent analysis

Table 3 Effect of Fuel Analysis on Boiler Efficiency

	Fuel A	Fuel B	Fuel F
Higher heating value	14,550	10,950	12,750
Per cent C	83.53	60.65	72.09
Per cent H_2	4.35	4.09	4.22
Per cent H_2O	2.50	12.00	7.25
Per cent O_2	2.14	6.00	4.07
Per cent S	0.74	4.10	2.42
Per cent ash	5.00	12.00	8.50
Per cent N_2	1.74	1.16	1.45
Per cent efficiency	88.75	86.40	87.52
Assumed Total air, per cent			116.2
Exit gas temperature, F			360.0
Entering air temperature, F			60.0
Carbon in refuse, per cent			4.0

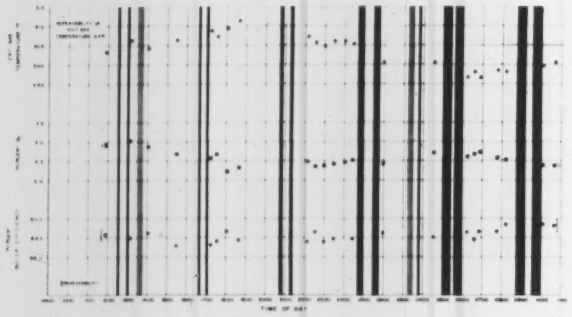


Fig. 8 The results obtained during a 24-hr period in a check of boiler efficiency with the DATAK system

selected by traversing the duct manually and selecting locations which give readings consistent with the average of the traverse.

This demonstrates that, for this boiler and this test, it would be possible to use only a few points in the matrix and obtain essentially the same results.

Data Accuracy

The various sources of error and uncertainties which exist in the system may be divided into two general categories: Static accuracy and random error.

The static accuracy is determined by error introduced at three places in the system: The primary elements and transducers, the scanners, and the analog-to-digital-conversion process.

In the case of temperature, the primary elements were iron-constantan thermocouples which were calibrated prior to the start of the test program and were assumed to be stable over the period of the test. This means that the errors introduced by the thermocouples were considered constant for the test period. The pressure, flow, draft, and differential transducers were calibrated prior to the test in such a manner as to minimize the error in the operating range. A check of these calibrations near the end of the test disclosed no change from the original calibration.

It is possible for the analog converters, that is, the scanners, to introduce errors from three sources: (*a*) The values of the circuit resistors; (*b*) the linearity of the analog conversion; and (*c*) the stability of the reference voltage. Since the linearity of conversion is a function only of the tracking of two slide-wires on the same shaft, this is assumed constant for the period of the test. The circuit resistors and reference-voltage stability were checked periodically throughout the test and no drift was found within our ability to field-check—which was 1 deg F for temperatures, and 0.1 per cent of ranges for flow, pressure, and differential.

The linearity and zero stability of the analog-to-digital converter is 1 digit in the least significant position, making this contribution to over-all error very small.

Thus it is concluded that the system calibration as influenced by the foregoing factors remained stable throughout any one test allowing direct comparison of answers without the application of correction factors to the data.

No estimate of the absolute accuracy of the results can be made. The time available for the Springdale tests precluded establishing an absolute calibration for the system. Therefore the real value of the tests was to establish the reliability and repeatability of the DATAK equipment. It was not possible to obtain information useful in evaluating boiler design, operation, or instrumentation.

Random errors are introduced in the data from several sources which may be grouped as follows: (*a*) that inherent in the equipment; and (*b*) that induced by environment. In this installation, it was not possible to detect any errors introduced by the environment, since whatever existed were masked by equipment errors.

In order to establish the repeatability of the calculated results, the repeatability of each measurement was established. By combining the results of tests on the analog scanners, analysis of the variation in hand-set items, and maintenance experience, it was possible to establish a repeatability for each data point of 0.1 per cent of the

range of the analog scanner, with the exception of the O_2 analysis and the hand-set items. The repeatability used in evaluating the computed results are listed in Table 2.

Computing Methods and Results

The data were processed on the DATATRON located in The Babcock & Wilcox Company computer section in New York. This is a stored-program magnetic-drum electronic digital computer with an internal storage of 4000 ten-digit words, and 400,000 ten-digit words of auxiliary storage on magnetic tapes.

In order that the computer program remain reasonable in length, no provision was made for applying correction factors to the data. This was justified since the principal object was to establish the stability of the data-taking system and the ability to detect changes in boiler conditions.

Two computer output forms were used: (*a*) Controlled format on the Flexowriter as a result summary; and (*b*) a punched paper tape containing the major results and some intermediate results. The punched tape was converted from computer code to teletype code for transmission to Springdale. The major results calculated from the DATAK data obtained at Springdale are: (*a*) boiler efficiency; (*b*) heat absorption; (*c*) gas temperatures; and (*d*) tube-bank conductances.

Examples of these results obtained during a 24-hr test of boiler efficiency are given in Fig. 8. The turbine was operating with the control valves in a fixed position to establish a constant load on the boiler. The soot blowers were operated in stages starting from the bottom and working to the top of the convection pass. The repeatability reported for the calculated results is a root-mean-square average of the repeatabilities of the measurements, weighted for the relative effect on the answer. This is not a rigorous means for error analysis but serves a purpose for estimating the dispersion of the results.

Boiler Efficiency. Boiler efficiency was calculated using the heat-loss method. The exit flue-gas temperature, O_2 analysis, and the entering-air temperature were measured; all other necessary information was entered as hand-set items. Obviously, the correct fuel analysis could not have been preset and values representing what could be expected from the coal source were used.

The validity of determining boiler efficiency in this manner may be established readily. The losses due to dry gas, moisture in the fuel, and hydrogen in the fuel constitute something on the order of 80 per cent of the losses. The remaining 20 per cent result from CO in the flue gas, combustibles in the refuse, radiation, sensible heat in the refuse, unburned hydrocarbons, moisture in the air, and so on. Because the losses represent about 10 per cent of the heat input, a 1 per cent error in determining losses results in a 0.1 per cent error in the determination of efficiency.

The losses due to dry gas, moisture in the fuel, and hydrogen in the fuel—about 80 per cent of the losses—are calculated from current data and expected fuel analysis. The remaining losses are entered from a knowledge of past history and expected fuel analysis. Past history furnishes the radiation losses, an agreed-upon "unaccounted loss," and the combustibles in the refuse. Of these, only the unburned combustibles category is subject to variation.

As an illustration of the effect of using hand-set items, Table 3 was prepared. Boiler efficiency was calculated using three different fuels and assuming the same values for total air, exit-gas temperature, and inlet-air temperature. Fuel A and Fuel B represent two coals quite different in analysis. Fuel F is a fictitious fuel having an analysis which is the average of A and B. If Fuel A was being burned, but the analysis for Fuel F was used in calculating the efficiency, a 1.23 per cent error would result. If Fuel B was being fired, a 1.12 per cent error in the other direction would result.

The "repeatability" in the boiler-efficiency calculation resulting from the use of DATAK data (exclusive of the question of obtaining representative flue-gas conditions, and the use of preset values of fuel analysis) is about 0.16 per cent. The exit gas temperature, O_2 analysis, and the efficiency are plotted for a 24-hr period in Fig. 8.

During another test period manual data were taken by The Babcock & Wilcox Company and West Penn Power Company personnel. When calculating boiler efficiency, The Babcock & Wilcox Company used DATAK values for total air, unaccounted loss, and unburned carbon loss, while West Penn Power Company made all measurements independently. A comparison of the results for a period when data were taken simultaneously shows a maximum deviation between DATAK and manual results of 0.8 per cent; 0.5 per cent of this deviation is accounted for by differences in the reported values of exit-gas temperature and oxygen analysis. The remaining 0.3 per cent resulted from the use of preset fuel analyses which were different from the ones actually experienced.

General Comments

An objective evaluation of the use of equipment such as DATAK is difficult to make since a great number of factors which influence the evaluation are hard to define in specific terms. We feel that DATAK can produce results which are at least equivalent to those obtained by manual means. The reliability and quality of the results have been fairly well established, and the questions of absolute accuracy can be resolved. Relative costs and the fact that a different kind of look at the boiler can be taken, are areas not so easily evaluated.

DATAK can obtain all temperature, pressure, flow, and draft data on a boiler and turbine in about 3 min. Analysis of O_2 requires another 1 min per point sampled. Manual means require considerably longer for collecting the same amount of data. This speed of data collecting opens the possibility for taking "snapshots" of the unit rather than time exposures and thus the opportunity to study operation in a new manner. Heretofore, it has been necessary to deal with time averages over a period of time on the order of an hour or more. Now it is possible to reduce this averaging period substantially.

DATAK, as built for this installation, will analyze nine flue-gas samples in 9 min, three times an hour, for as long a period as desired. A man with an orsat could analyze nine samples in 1 hr for the first few hours, after which he would need relief. DATAK reads temperatures, pressures, and so on, at the rate of one a second, or faster, and does not tire. It would be very difficult to match this performance with men.

Contrast the machine and man doing the same job. The machine has high initial cost, but lower operating cost. The machine is faster and more consistent, and does not tire.

Dust and Fume

By J. C. Somers, Mem. ASME

President, Industrial Products Engineering Company, Long Island City, N. Y.

How to eliminate industrial dusts, fumes, odors, and toxic conditions from the modern industrial plant

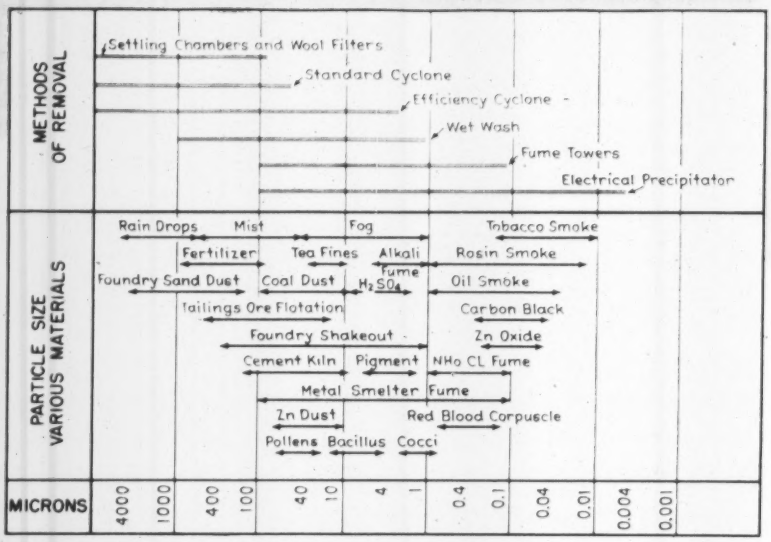


Fig. 1 Methods of collection and particle size

ENGINEERING and design of dust or fume-control systems are basically a problem of controlled movement of these materials which are in the form of small solids or very fine solids, vapors, or gas. The problem is essentially one of limited theoretical calculation and broad understanding of the movement of gas and air, and detailed familiarity with construction of equipment to collect the fine solids or mixture of air, solids, or gases.

Gases and vapors, nonmetallic and metallic materials, and nontoxic dusts find their way into the atmosphere. Such items as chlorine, benzene, phosphine, sulphur dioxide, and a score of others are more dangerous than carbon monoxide. Cadmium and antimony are definitely and rarely above the danger limit. Yet along with lead they stand higher as contaminants than iron oxide. A high-silica dust or asbestos bears careful scrutiny under any condition. These are a few items among many hundreds which have to be controlled and handled.

Tables giving safe limits of contaminants, gases, vapors, dusts, and the like, are available to the engineer concerned with the problem. To keep under these safe limits in working or living areas often requires complete removal of the material.

Contributed by the Materials Handling Division and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9–13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 57—SA-86.

Equipment Used

The equipment used consists of hoods, ducts, pipe and fittings, headers, fans or exhausters, and finally dust and fume-collection equipment. Of these, mechanical engineers are generally familiar in some form with all but the collection equipment. Usually access to regular texts on heating, ventilation, and air conditioning, or handbooks and the standards established by agencies concerned with safety and dust, and fume suppression, will help. However, the selection and sometimes the design of dust-collection equipment constitute a major problem.

Capacity and type of particle to be removed are primary considerations in the choice of a collector. The available location, and facilities for the disposal of the material, as well as cost factors, and conformance to state, county, and municipal regulations, all have bearing.

Problem of Particle Size

Most dangerous dusts and fumes are not visible to the naked eye. Indeed, many pigments, mists, smelter dust, some coal, and similar materials can be seen only under the microscope, with other dusts and fumes visible only under the polar microscope. Fig. 1 best illustrates these conditions. To talk intelligently about collection equipment necessitates a good condensed picture of efficiencies of collector for dusts of various particle sizes. To illustrate, the following is the dust analysis of a specific material:

Control

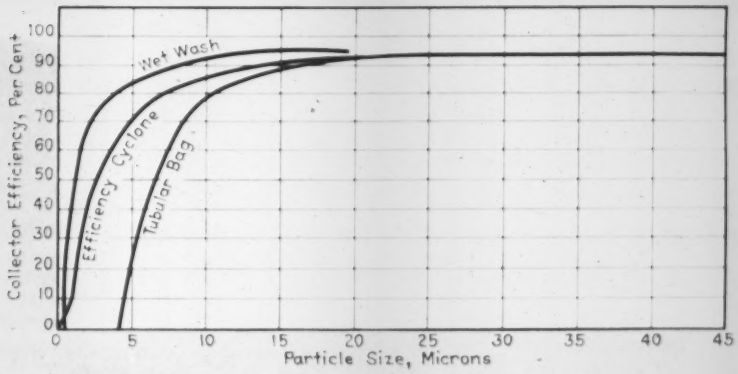


Fig. 2. Collector efficiency varies with the type of collector

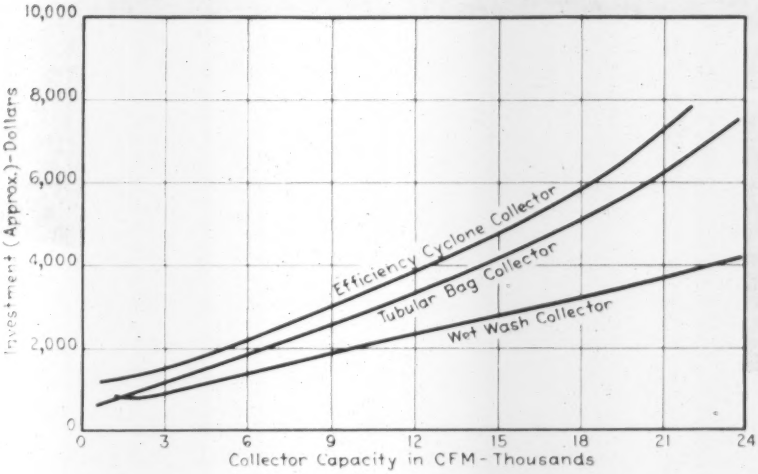


Fig. 3 The approximate investment at FOB factory prices without delivery and installation costs, for collector equipment only

Under 10 microns	30 per cent of all particles
10–40 microns	50 per cent of all particles
over 40 microns	20 per cent of all particles

For this particular dust, efficiency on various collector equipment would be as follows:

Standard cyclone	to 70 per cent of all particles
Efficiency cyclone	to 90 per cent of all particles
Tubular bag	to 94 per cent of all particles
Centrifugal wet	to 96 per cent of all particles
Wet wash	to 97 per cent of all particles
Wet tower	to 98 per cent of all particles
Electric precipitator	to 99 9 per cent of all particles

Types of Equipment

In general there are five broad classifications of collection equipment: (*a*) cyclones, (*b*) cloth arresters, (*c*) wet collectors, (*d*) fume towers or filters, and (*e*) electrical precipitators.

Cyclones

Cyclones are used exclusively on dusts and strictly dry materials without contaminant fume. Basically, the unit depends on centrifugal action to separate the dust from the air. Directional change as high as 360 deg is effected in the air stream in order to get high separation. Material to about 60 to 80 microns in particle size can be handled. Efficiency will run up to 80 per cent, with average as low as 70 per cent or even less.

A special type of cyclone is the "efficiency" or tubular collector, which depends on centrifuging action in a volute. This is set above the collector proper, and centrifugal action within may follow a shave-off where a separation of fines occurs and some special centrifuging action, such as a figure "8," may occur. The same limitations as to characteristics of material apply. With particles of even less than 10 microns, efficiencies of 95 per cent are common on certain materials.

Another type of cyclone has a central multibladed rotor. Separation is based on the difference in specific gravity of the air and the dust. Dust is made to travel into a discharge chute by a form of scroll sheet. Limited in application to dry dusts, efficiency is slightly higher than the conventional cyclone, about 80 to 90 per cent.

In general, cyclones are constructed with a top vertical round section and a bottom cone, having a dust outlet, which is usually discharged to a box or drum or other container. On more efficient units a rotary air lock or other type of gate is necessary to withstand high static pressure.

Cloth Arresters

These depend principally on reduction of speed of air in the settling section where limited separation occurs; and the application of a cloth filter to accomplish the major portion of the separation.

There are three types, namely, the tubular bag, the cloth envelope, and the screen. All depend on filtration through a tightly woven cloth, usually sateen, for temperatures under 200 F. Dust must be relatively dry and must not affect the cloth fiber chemically or abrasively. Nylon, orlon, and certain asbestos or special fabrics are used for special applications. The tubular bag which gives maximum cloth area per cu ft of collector is the most common of the three cloth arresters. Area of cloth is determined by linear ft velocity of dust-laden air per ft of cloth. The rate will vary from 5 to 15 fpm.

Various vibrator or eccentric-type mechanisms are used to provide electrically operated shaking to free the bags of clinging particles as filtration efficiency diminishes.

Wet Collectors

The general principle of water action is to establish intimate contact between the fine particle of vapor, dust, or the like, and a fine spray of water. There are four general types of wet collectors.

The Multiwash Type. Wet centrifugal action with a great number of water washes and impingements is the principle of the multiwash type. The dust-laden air is saturated thoroughly with water or other liquid and thrown against impingement walls, shelves, or baffles. The water washes the dust or fume into the settling tank or to the disposal system. The only maintenance required is for the pump or water supply. Operation of the collector is not affected by temperature of the air, moisture, or steam; and abrasive or adhesive materials can be handled. Next to the electrical precipitator, this is one of the two most efficient collectors, and maintenance and operating expenses are less. Air under suction travels upward in a tower, and water is recirculated at 10 gal per 1000 cfm. Where recirculating tanks are used, the settling rate must be determined in order to provide adequate supply of clear water.

Orifice-Type Collectors. In this unit, consisting of a rectangular tank, dust-laden air under suction sweeps water and air through an orifice. At the throat of the orifice, which is merely a scroll, high-velocity air and water quickly expand into a chamber, creating a multitude of blankets. These sweep down into the tank and carry the dust or fume which is well wetted by the water or other liquid.

This type of unit requires no pump. By a constant-level device, the proper quantity or level of water is maintained. If necessary, constant sludge ejection can be maintained. Efficiency is about the same or higher than with the foregoing systems and requires less maintenance or attention. Range of dusts and fumes, including cold sand, many acids, and similar materials is much higher. Units are more compact and can be installed anywhere that a rectangular tank may be located. Packaged units up to 15,000 cfm can be obtained. Water rates run about 50 gal per 1000 cfm.

Wet Centrifugal Cyclone. The design of this equipment is simple. It is a standard cyclone with groups of nozzles located in the top entry section spaced at 90 deg intervals. Air sweeps through and is centrifuged around 360 deg through the intense water spray. This unit is usually designed without recirculating pumps although they can be installed. Water is drained to the sewer or other disposal at rate of about $^1/_2$ gpm for each 1000 cfm. Efficiency on this unit will run about 10 per cent under wet collectors. It is generally not recommended for fumes except where they are extremely soluble in water. Air is blown through this type of collector. A specially designed handhole and cover give access to nozzles for quick cleaning.

Oil Froth-Type Wet Collector. Air is bubbled through the collection media such as water, with oil introduced to break the surface tension. This produces smaller bubbles and better collection of fine materials than usually found in the fresh-air supply system or in reused conditioned air. The disadvantages are many. A level floor is required or a plate to hold the oil and water. The heavier particles build up. Frequent cleaning is necessary. Sometimes the bubbles take dust into the air. If exactly the correct amount of oil is used to get efficiency, the amount of froth becomes objectionable. Air will then taste oily.

Electric Precipitator. This is the most efficient type—micron-size oil particles, smoke, and fumes may be collected. The dust collection results from ionization of the particles which then are drawn by suction through positively and negatively charged condenser surfaces where they are held by the electric charge. These plates or tubes can be cleaned by release and dust removed by handling methods. To a limited extent, moisture has no effect, although gumming of plates or tubes may result from wet or certain adhesive materials. Heat has also no effect.

Fume Towers or Filters. Here the conventional-type washer is supplemented with either a catalyst and/or wet agent with special packing of certain ceramic or other material using an agent. With these units the construction is such that field assembly is possible, especially in larger sizes.

Best construction consists of a bottom round wet section with support plates including the fume inlet; above this is the pack section which would include nonmetallic mineral or items such as "Intalox."

Immediately above is the liquid inlet pipe with a manifold and a spray section to distribute the agent evenly. Above this unit with a flange is the blower inlet, or in smaller units a vertical fan arranged with flanged bottom to accommodate the spray section. Usually a chemical analysis of fume is essential, and proper specification of liquid such as low-concentration caustic or sodium carbonate is used. The bottom wet section can be designed or is available so that water can be recirculated with a pump to reduce concentration.

A special adaptation of the preceding unit is the catalytic unit without a tower. Fresh air is bled or blown into the exhaust fume. The fume-laden air is then passed through a filter which eliminates most solids down to 3 to 5 microns. The fume-laden air then enters one or more catalytic units where the toxic or harmful gas is decomposed. Usually a pyrometer is installed to insure safety along with other recording and indicating instruments. Unit sizes will depend on the fume. Usually 10,000 cfm or less can be handled in one unit, although good practice suggests multiples of 2500-cfm.

Conclusions

For safety, health, economic, and plant operation reasons, adequate dust and fume collection and separation installations are necessary. Important among many considerations on this problem are (*a*) proper engineering layout of the complete system, however small; (*b*) observance of codes of private agencies as well as those of government; (*c*) investigation of safety limits of particular dust or fume used in the layout; (*d*) investigation of dust loading in the system proposed to insure adequate operation, disposal of material, etc.; (*e*) knowledge of particle size or characteristics; (*f*) efficiency of separation of dust or fume required; (*g*) proper techniques and procedures in selection of collection or separation equipment; (*h*) the analysis or economic consideration regarding complete capital investment and operation costs; (*i*) finally, results spelled out in preparation of final layout and proposal.

How to DRILL 6AL-4V TITANIUM ALLOY

By G. P. Campbell and A. Searle, Boeing Airplane Company, Seattle, Wash.

TITANIUM has unusual chip-formation characteristics and thermal properties which make it difficult to drill. The thickness of the chip is thinner, being approximately the same as the depth of cut; whereas with most other materials the chips are two or three times the depth. Thinner chips flowing across the face of the tool at a higher velocity, together with the extreme pressures required for cutting, mean higher concentrations of heat at the point of cutting. Once a spot of the material is heated, the heat does not readily flow away through the workpiece or chip.

The unusual thermal properties of titanium—relatively low volume, specific heat, and low thermal conductivity—have a marked effect on drill life. Preliminary tests were marked by short drill life. Drills of small diameter would break easily because of the deflection of the drill under the high thrust force required for hand drilling. In power-feed drilling, however, there was no breakage but still exceptionally short drill life—an average of only 8 to 10 holes per drill, with some drills dulling on the first hole. This short drill life was caused by overheating of the drill point and rapid breakdown of the cutting edge.

When conventional drilling procedures are used on titanium, the drill point and chips become very hot, and have a tendency to weld to the cutting edge. This causes clogging of flutes, generates more heat, and aggravates the condition, resulting in the premature dulling and the drill failure encountered in preliminary tests. Some of the preliminary tests run on 6A1-4V titanium resembled our initial experience on the drilling of 17-7 stainless steel. Comparison tests were run on 17-7 stainless steel and 6A1-4V titanium alloy. It was found that the stainless steel, drilled under the same conditions as the titanium alloy, required the same high-thrust forces and resulted in low drill life. These comparisons are shown in Figs. 1 and 2. As a result, the problems in drilling titanium alloys appeared to be no greater than those of drilling stainless steels, although the conditions causing the problems were somewhat different. It is now known that successful machining of titanium alloy depends on being able to reduce the heat generated at the cutting edges of the tool.

Basically, this can be accomplished in three ways: (*a*) By reducing the cutting speed; (*b*) by reducing the feed rate; and (*c*) by using a flood of coolant on the tool and workpiece.

The speed and feed changes are dependent on machine design, and the use of a coolant is dependent upon the operation itself.

Contributed by the Aviation Division and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9-13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 57—SA-71.

Drilling Tests

A series of tests was conducted with the following objectives:

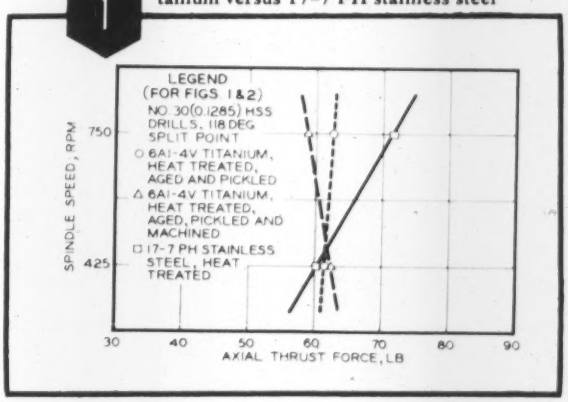
1 To determine the drilling characteristics of 6A1-4V titanium alloy.

2 To gain sufficient knowledge to solve production problems that might arise because of using the alloy.

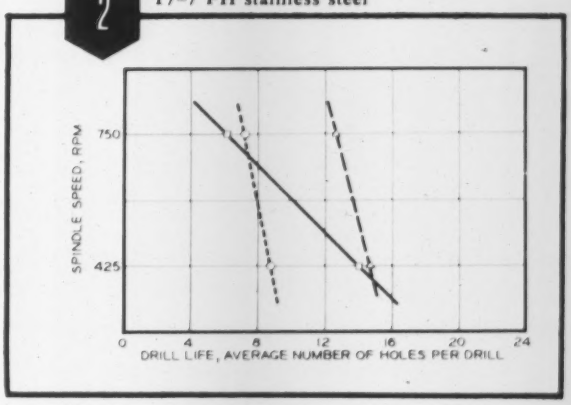
3 To determine the tooling that will be required for production drilling of 6A1-4V titanium.

Experimentation thus far has been carried out in two categories of drilling operations:

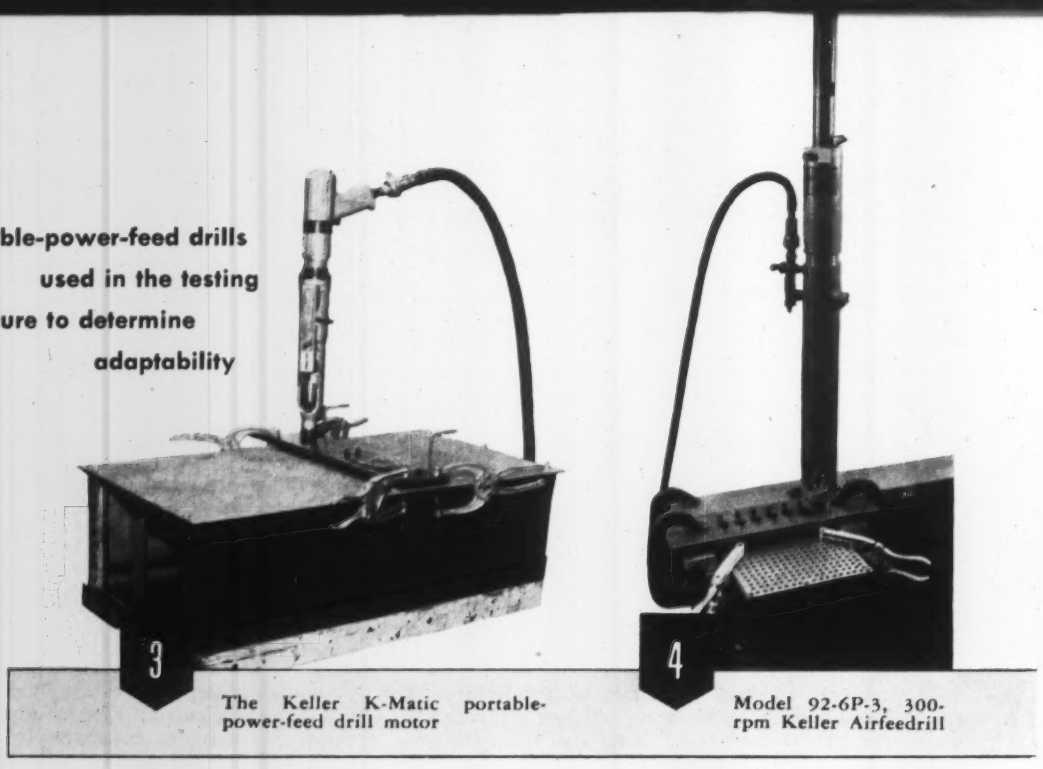
1 **Preliminary comparison testing of the axial thrust force of 6A1-4V titanium versus 17-7 PH stainless steel**



2 **Preliminary comparison testing of the drill life of 6A1-4V titanium versus 17-7 PH stainless steel**



Portable-power-feed drills used in the testing procedure to determine adaptability



The Keller K-Matic portable-power-feed drill motor

Model 92-6P-3, 300-rpm Keller Airfeedrill

1 *Portable-power-feed drilling.* This is accomplished with portable drill motors incorporating a power feed and requiring a holding device to withstand the thrust developed. The drill motors used for this phase of the test program were selected for the purpose from ones currently available at Boeing Airplane Company. A Boeing-designed and built dynamometer equipped with a Brush analyzer and recorder was used to measure and record the thrust forces developed. Since preliminary drilling tests showed low torque values, torque values were not recorded for the remainder of the program.

2 *Free-hand drilling.* In free-hand drilling, the tools are held in the operator's hands and fed into the work by the axial force applied by the operator. The drill motors used for this phase of testing were slow-speed, heavy-duty, production-type air motors.

The drilling dynamometer and recording instruments were used to determine the thrust forces required to keep the drill cutting. No torque forces were measured.

Test Procedure

A Portable-Power-Feed Drilling. The portable-power-feed drilling tests were conducted with three basic units:

1 Keller "K-Matic," positive mechanical feed.
2 Keller "Airfeedrill," variable pneumatic feed.
3 Winslow "Spacematic," variable pneumatic-hydraulic feed.

The objectives were the determination of the adaptability of these units to the machining of titanium, and the development of the best combination of feeds, speeds, drill material, and drill-point geometry for optimum results.

1 *Keller K-Matic.* The drill motor used for this test, Fig. 3, was a recent development. It incorporates a positive mechanical-feed mechanism, a depth control, and an automatic return. The model used for this test, model 94A-31-1 1/4-2, had a free speed of 550 rpm at 95-psi operating pressure, and a constant-feed rate of 0.002 in. per rev. This unit is capable of exerting up to 1000 lb thrust.

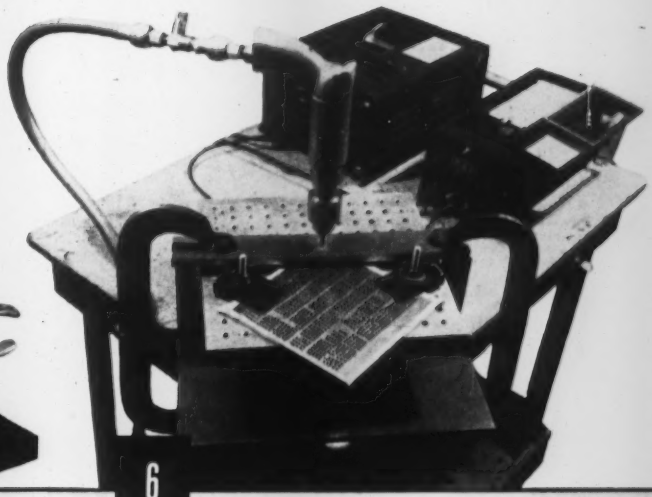
The thrust forces developed with this unit when drilling 6A1-4V titanium (heat-treated to 170,000 to 180,000 psi) ranged from an average of 55 lb for No. 30 (0.1285) drills to an average of 126 lb for one-fourth-in-diam drills. These drills were ground with a 135-deg included-point angle, split point, and 10 deg to 12-deg lip-relief angle. The drill material was M-10 tool steel (8 per cent Mo, 4 per cent Cr, 2 per cent V). Varying the drill-point angle had no significant effect on drill life, hence the NAS 907 Type B or Type C point may be considered the optimum, inasmuch as it is a standard grind.

Of the drill materials tested, M-10 high-speed steel, M-3 Type 2 tool steel, and M-36 cobalt high-speed steel, M-10 high-speed-steel drills are considered to be the best for use with power-feed equipment. This is based on apparent drill life and unit cost. No attempt was made to establish drill life; however, each drill tested produced in excess of 70 holes, with one drill going as far as 150 holes without appreciable wear before the test was discontinued. The unit cost of high-speed-steel drills is approximately 51 per cent of the cost of M-36 cobalt drills and 25 per cent of M-3 Type 2 drills.

The results of the drilling test showed that a Class 1 hole tolerance, $\frac{+0.004}{-0.000}$, can be maintained in a "one-shot" operation. A $\frac{+0.002}{-0.000}$ hole tolerance was held in a drill-and-ream operation.

2 *Keller Airfeedrill.* A model 92-6P-3, 300-rpm Airfeedrill taken from the production shops was considered the most suitable unit for this test because of its lower speed range, Fig. 4. The air feed was adjusted to give a feed rate of approximately 0.0028 in. per rev at free speed. This unit is rated at 0.54 hp with a stalling thrust of 320

5 Winslow Spacematic model HD-1600 self-supporting and self-indexing unit



6 All tests were run with a drilling dynamometer and a Brush analyzer and recorder

lb and an air-consumption rate of 23 cfm at 90-lb operating pressure. The thrust forces developed with this unit varied with the feed rate adjustment. A 0.0028-in-per-rev feed resulted in a thrust force of 104 lb, and a 0.0017-in-per-rev feed gave a thrust of 68 lb when using $^1/_4$-in-diam high-speed-steel drills. This unit requires a drill with a minimum length of 5.75 in. For optimum performance it is important to keep the flute length as short as possible. The short flute length increases the rigidity of the drill and reduces the chatter caused by torsional windup. The 135-deg included-point angle with a split point NAS 907 Type B produced optimum results with this equipment. A Class I hole tolerance, $^{+0.004}_{-0.000}$, was easily maintained in a "one-shot" operation. A $^{+0.002}_{-0.000}$ tolerance was held in a drill-and-ream operation.

3 *Winslow Spacematic Model HD-1600.* This unit is a new development, and has shown great promise in airframe manufacturing. It is self-supporting, self-indexing equipment utilizing an expanding collet for its self-supporting feature, and is capable of drilling and countersinking in one operation, Fig. 5. The unit used for this test had a free speed of 400 rpm and the feed rate was adjusted to approximately 0.0025 in. per rev. This unit is rated at 0.92 hp with a thrust or clamping pressure of 750 lb and an air-consumption rate of 35 to 37 cfm.

When drilling titanium with this unit, it is necessary to use special drills of M-3 Type 2 tool steel. Preliminary tests indicated that modification being undertaken by the manufacturer would be desirable, with larger diameter drill bodies, and a reduced countersink rake angle. The results of the preliminary tests were more than encouraging and show a great potential. Holes for $^3/_{16}$ and $^1/_4$-in-diam rivets were drilled and countersunk in 0.320 6A1-4V heat-treated titanium with a cycle time of 40 to 60 sec per hole. A $^{+0.002}_{-0.000}$ hole tolerance was held, in the combined drilling and countersinking operation. Drill life can be improved by experience. An average of 14 holes per drill was attained with one drill drilling and countersinking 48 holes with nominal point wear.

B Free-Hand Drilling. Free-hand drilling of titanium alloys presents the area of greatest difficulty. Hand-held portable tools must be used without coolant, and the difficulty is compounded. Early attempts at hole production with conventional methods resulted in triangular-shaped holes instead of round holes, the drill life was extremely short, 3 to 6 holes per grind, and the high axial-thrust forces required to keep the drill cutting caused rapid operator fatigue. A statistical approach was used to determine the best combination of speeds, tool material, and tool geometry. All tests were run with a drilling dynamometer and a Brush analyzer and recorder, Fig. 6. For these tests the minimum thrust necessary for good chip removal was applied. Optimum results to date were attained using cobalt drills with a 90 × 130-deg double angle, split point, and a speed of 750 rpm (Table 1 and Figs. 7 to 9). This information applied to No. 30 (0.1285) drills only.

This drill configuration resulted in metal removal of 0.0112 cu in. per min, an average drill life of 31.3 holes per drill at an axial trust force of 38.5 lb. These tests were conducted with the following variables: 1 Speeds: (*a*) 425 rpm, (*b*) 750 rpm. 2 Drill material: (*a*) high-speed steel, (*b*) cobalt, (*c*) M-3, Type 2. 3 Drill geometry: (*a*) 118-deg included angle, split point, (*b*) 135-deg included angle, split point; (*c*) 90 deg × 130-deg double angle, split point.

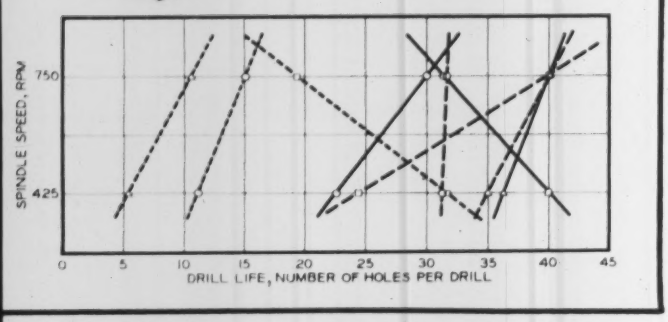
Future tests are presently in planning to further the development of optimum tools and techniques for free-hand drilling. These tests will evaluate various point angles for larger size drills, $^3/_{16}$ in., $^1/_4$ in., and $^5/_{16}$-in. diam, to determine the point geometry requiring the

Table 1 Titanium Drilling Data*

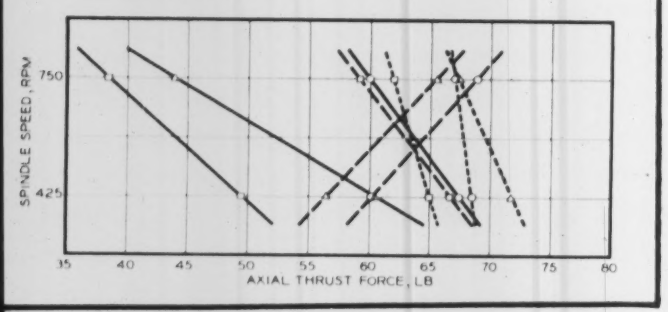
Test no.	Drill material	Drill point angle, deg	Speed, rpm	Feed,† in. per rev	Average number holes per drill	Average thrust, lb	Average time (sec)	Metal removal rate (cu in. per min)
1	Cobalt	118	425	0.001	22.6	67.4	33.5	0.00548
2	Cobalt	135	425	0.00128	36.3	60.5	26.4	0.00694
3	Cobalt	90 × 130	425	0.00163	40	49.5	20.5	0.00892
4	HSS	118	425	0.00072	11.2	68.5	46.5	0.00392
5	HSS	135	425	0.000785	5.4	71.7	42.6	0.00429
6	HSS	90 × 130	425	0.00089	31.6	65	37.8	0.00485
7	M-3, Type 2	118	425	0.00113	31.4	60.4	29.8	0.00615
8	M-3, Type 2	135	425	0.00133	35	56.5	25.2	0.00732
9	M-3, Type 2	90 × 130	425	0.00154	24.3	66.8	21.9	0.00837
10	Cobalt	118	750	0.00125	30	60	15.05	0.01215
11	Cobalt	135	750	0.00123	40	44	15.18	0.01212
12	Cobalt	90 × 130	750	0.00115	31.3	38.5	16.4	0.01120
13	HSS	118	750	0.00126	15.1	67	14.8	0.01228
14	HSS	135	750	0.00089	10.6	67.4	21.3	0.00865
15	HSS	90 × 130	750	0.00095	19.3	62	22.2	0.00926
16	M-3, Type 2	118	750	0.00116	31.6	68.9	16.33	0.01125
17	M-3, Type 2	135	750	0.000845	40	65.6	22.3	0.00823
18	M-3, Type 2	90 × 130	750	0.00103	40	59.2	18.6	0.00982

* No. 30 (0.1285) drills.
Total number of holes drilled—1575.
Material—6AL-4V titanium, H.T. 170,000 to 180,000 psi.
Material thickness—0.235 in. (1) sheet 0.160 in. + (1) sheet 0.075 in.
Process for material: Protective coated, heat-treated and water-quenched; age-hardened and pickled.
† Based on free speed, and time through material.

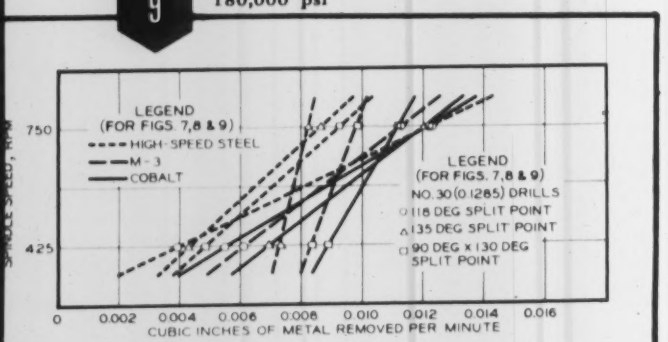
7 **Drill-life data for free hand drilling of 6A1-4V heat-treated to 170,000 to 180,000 psi**



8 **Axial-thrust-force requirements for free hand drilling of 6A1-4V heat-treated to 170,000 to 180,000 psi**



9 **Metal-removal-rate data for free hand drilling of 6A1-4V heat-treated to 170,000 to 180,000 psi**



lowest axial thrust force for the optimum in chip removal and the maximum in drill life.

Conclusions

These tests serve as a basis for certain general conclusions and recommendations for drilling titanium.

1 Cutting speeds of 20 to 30 surface ft per min will result in the best tool life for drills of the M-10 molyvanadium type steel (8 per cent Mo, 4 per cent Cr, 2 per cent V) and M-36 cobalt (6 per cent Mo, 2 per cent V, 6 per cent W, 8 per cent Co).

2 Allowing the drill to rotate in the hole without cutting causes a rapid dulling of the cutting edge, and further cutting becomes extremely difficult.

3 Very sharp cutting edges are required to cut titanium. Dull drills cause a rapid increase in the axial-thrust force required to cut. Drills should be changed at the first sign of dulling.

4 The short NAS 907, Type C drill should be used for sheet-metal drilling wherever possible since it is more rigid, and torsional vibration is reduced. Where bushings or depth of hole prohibit the use of the short Type C drill, the Type B drill should be used.

5 Rigidity of the workpiece and elimination of gaps between sheets are important to drill life.

6 Accurate, machine-ground drill points with a fine finish will result in more holes per grind than drills sharpened by hand on rough wheels.

7 The 135-deg included-angle split point is considered the optimum point for drill press work and portable-power-feed drilling equipment.

8 The 90 by 130-deg double angle is considered the optimum point for minimum thrust and adequate tool life with portable-hand-drilling equipment.

9 Thrust forces in drilling titanium are higher than those encountered in drilling aluminum and mild steel, and are such that portable hand drilling should be done in conjunction with pilot holes and limited to a maximum of $^{5}/_{16}$ in. in diam.

Recommendations

1 Slow-speed high-torque drill motors of the proper rpm should be used in drilling titanium.

2 Adequate training programs are needed for shop personnel to familiarize them with the necessary precautions and drilling procedures, in order to minimize drill usage, and regrind and produce high-quality hole tolerances and finishes.

3 The NAS 907, Type C drill should be used for drilling sheet titanium and the Type B drill used where the Type C is too short because of bushing length or hole depth.

4 M-10 tool steel should be used with drill-press operations and portable-power-feed equipment. Cobalt drills are recommended for portable-hand-drilling operations.

5 All drill points should be machine-ground and inspected for accuracy of grind; that is, point angle, lip length, lip-relief angle, and the like, per NAS 907, Type B or Type C.

6 Drills with 135-deg included angle, split point, and 0-deg rake angle should be used for all drill-press operations and portable-power-feed equipment.

7 Drills with a 90 by 130-deg double angle, split point, and 0-deg rake angle are recommended for hand drilling.

MAN and his THERMAL ENVIRONMENT

To solve the man-machine problem, engineers confront a new design factor — human tolerance to heat or cold[1]

Factors in Heat Stress[2]

In physical terms, a man is a body which generates heat by metabolism. This heat is mostly dissipated at the skin surface, although some energy may be utilized in doing mechanical work and some is dissipated from the lungs. In general, if the amount of heat generated exceeds that dissipated from the skin, the man becomes warmer; if it is less than the heat loss, the man cools. The strain on the man from any environment will depend largely on this fact, and methods of estimating heat loss from the skin are a necessity before progress can be made.

The skin can be treated as a heated and generally moistened surface which is losing energy to the surroundings by convection, radiation, and evaporation. Heat transfer, as considered in most standard textbooks, consists of conduction, convection, and radiation. To these three must be added evaporation since it is an important factor in dealing with man's heat exchange. Any heat transferred by conduction from a surface to air is eventually carried away by movement of the air, and the whole process of conduction and convection is, for purposes of simplification, termed convection.

(The authors develop equations to express the energy exchanges in terms of: convective heat transfer, net radiative heat transfer, evaporative heat transfer, convective coefficient, radiative coefficient, evaporative coefficient, surface temperature, air temperature, mean radiative temperature of surrounding objects and surfaces, water vapor pressure of surface, and water vapor pressure of air. From these equations it is shown, for example, how to calculate the temperatures and humidities at which man can maintain thermal equilibrium when he must lose a certain number of Btu/sq ft/hr from his skin.)

In the human problem, two distinct conditions can occur. The first of these is where all secreted sweat is evaporated, hence it is called the "dry-skin" condition. Here the amount of evaporative cooling is determined by the amount of sweat secreted and not by how much moisture can be evaporated by the air. If air temperature is above skin temperature, heat is gained by convection. The higher the wind speed, the greater will be the heating effect. Typical examples of such conditions are the desert environment with its hot winds, or the hot-air blasts found in some industrial plants.

The second condition is one in which sweat secretion is high enough so that all of it is not evaporated and some drips off. In these circumstances, cooling is not limited by sweat secretion but by the ability of the environment to evaporate the sweat. Accordingly, sweat-secretion rate bears no relation to evaporative cooling. Under such conditions an increase in air vapor pressure decreases heat removal by evaporation, while an increase in wind speed increases it. Thus a fan provides relief on humid days by increasing the potential for evaporative cooling.

Effect of Clothing

The discussion has dealt with heat exchange between an uncovered surface or skin and the environment. The basic equation will apply to the clothed man if the coefficients of convection, radiation, and evaporation are modified. The convective heat-transfer coefficient for the so-called "still air layer" over the surface is changed to one for clothing plus air. The radiation coefficient must be reduced since clothing acts as a radiation shield. The evaporative coefficient also must be adjusted to correct for differences between the moisture permeability of air and clothing. Since, in general, clothing will have a lower permeability to moisture than a still air layer of equal conductivity, a coefficient of moisture resistance to vapor transfer is included in the general equation.

Variations in air movement, skin temperature, and sweat rate over different areas of the skin surface lead to a very difficult and impractical mathematical treatment. It is, therefore, necessary for the biotechnologist to use the best physical analysis available as a basis for his reasoning, modify his results somewhat using laboratory data, then add his skill and judgment to obtain a good reliable index.

The Body as a Heat Exchanger[3]

The human organism differs from other heat exchangers in that its heat-regulation reflexes may be said to be a servomechanism with a complicated yet con-

[1] Based on six papers contributed by the Heat Transfer Division and presented at the Semi-Annual Meeting, San Francisco, Cal., June 9–13, 1957, of The American Society of Mechanical Engineers. Multilithographed copies of the original technical papers may be ordered, by number, from the ASME order department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members, 50 cents to non members.

[2] Condensed from "Analysis of Energy Exchange Between Man and His Environment," by Dr. Alan H. Woodcock, Chief, Biophysics Branch, J. R. Breckenridge, Physicist, R. L. Pratt, Meteorologist, and J. J. Powers, Jr., Mathematician, Biophysics Branch, Quartermaster Research and Development Command, Natick, Mass. ASME Paper No. 57—SA-64.

[3] Condensed from "The Biotechnical Problem of the Human Body as a Heat Exchanger," by L. P. Herrington, The John B. Pierce Foundation, New Haven, Conn., member of The Committee on Biotechnology of the Heat Transfer Division of The American Society of Mechanical Engineers. ASME Paper No. 57—SA-5.

Table 1 Mean[a] Values of Calorimetric Data, Mature Male Subjects, Normal Clothing, Seated Posture

	Skin temp	Air temp	Radiant temp	Operative temp[a]	Metabolism	Evaporation
Mean	85.25	49.02	71.52	61.61	91.55	−20.86
Std deviation	3.26	10.70	16.15	10.17	7.72	5.70
Population[b]	180	180	180	180	180	180

[a] Operative temperature resembles in principle the process of reducing a gas to a reference volume and pressure. It may be understood in a sensory sense as the temperature of an enclosure with walls and air at the same temperature, and with an air movement of 15 to 20 fpm, with relative humidity of 50 per cent.

[b] Each item in the population is an exposure to a given calorimeter combination of air and radiant temperature for 3 hr.

NOTE: Temperatures, deg F; metabolism and evaporation, kg cal per hr per man; avg height 180 cm; avg weight 70.8 kg; avg DuBois surface area 1.76 sq meters; avg radiation area 1.34 sq meters.

sistent method of responding to heat or cold stress. The nature of this patterned response is such that, in contrast to inanimate heat exchangers, the following properties of the human heat exchanger may undergo complex interrelated alterations over even a small range of ambient temperatures (area 70-90 F):

(*a*) Heat input to the exchanger.

(*b*) Alteration of the conductance of the peripheral material of the exchanger.

(*c*) Alteration of the total conductance from surface to ambient surround.

(*d*) Shift of heat-dissipating load from a low surface-volume ratio exchanger segment (the trunk) to a segment of higher relative surface (extremities).

(*e*) Conversion of the surface process of the exchanger from a dry-heat transfer to a combined dry-heat and evaporative process.

It has been necessary to make calorimetric studies of the human heat exchanger by use of the classical heat relations. It must be obvious, however, from an inspection of the servoproperties that a large amount of physiological study is required if an engineer desires to apply the classical relations to an immediate problem. He must be able to decide what the control state of the human heat servomechanism is for a particular ambient condition or a particular state of work stress in the organism.

This difficulty becomes clear from the following classical heat-exchange relations for the human body. In making this inspection the question may be asked as to how one proceeds with the computation, taking due account of the features of heat-exchanger behavior noted (*a* − *e*) as continuously varying properties of the experimental object.

Radiation Exchange The equation for heat transfer by radiation between the unclothed human body and the environment is given by

$$H_R = 1.37 \times 10^{-11}(T_s^4 - T_e^4)tAfe, \text{ kg cal/hr} \quad [1]$$

where T_s = average skin temperature (deg C + 273), T_e = average radiant environmental temperature (+ 273), t = seconds in one hour, A = DuBois surface area, f = ratio of effective radiating surface to the DuBois surface area (0.78 for the unclothed adult in recumbent position), and ϵ = emissivity of the environment.

Conduction Exchange. Clothing and other factors normally reduce human conductive heat to a small fraction of the total exchange. However, the familiar classical equation is frequently applied to the problem of computing the alteration in the conduction of heat from the interior of the body to the surface.

(The author then develops equations for *heat loss by convection* (some degree of forced convection is generally present in human heat exchange) and for *heat loss by evaporation*, a variable of wide range in the biological heat-exchange process.)

The Design Situation

The most frequent engineering requirement involving human heat loss requires the estimation of a resultant skin temperature regarding the problem of heat tolerance. Such design situations are generally too unusual to be settled by reference to data for the circumstances obtaining in ordinary air-conditioning problems. In other instances the problem is to estimate the stress effect of an increase in the radiant temperature of an environment, or to estimate the highest level of activity (heat input) consistent with fixed environmental heat effects.

In all such instances, a linear multivariable equation, permitting values to be fixed for four of the chief variables with solution in terms of a remaining variable, is of great usefulness.

The calorimetric log of human heat-exposure experiments of the author and associates at the Pierce Foundation Laboratory of Hygiene has been abstracted for the basic data of such a computation. In 180 calorimeter experiments on mature, normally clothed male subjects, the mean values of Table 1 were found for the group of 3-hr exposures. All of these experiments were under conditions which do not stimulate positive sweating.

The mean values given in Table 1 represent 180 numerical values distributed among six variables. To express these 180 values in a single equation requires the determination of the regressions between every possible combination of the six variables. Since operative temperature is derived from air and radiant temperature, the calculation program was reduced to one dealing with the five remaining variables. The Pearson product-moment method was applied to determine the 10 least-square solutions existing in the system of variables. From these intercorrelations the four partial regressions were determined, representing the relation between four pairs of variables with the influence of the remaining three variables removed mathematically.

This is a tedious operation and time-consuming, but the end result is very efficient in that it enables us to derive the following five-element equation from which the entire table of 180 data entries may be regenerated with surprisingly small deviation between the values of the regenerated table and the actual observational data from the calorimeter.

$$X_1 = 0.286X_2 + 0.142X_3 + 0.105X_4 + 0.092X_5 + 53.39$$

$$(T_S) \qquad (T_A) \qquad (T_W) \qquad (M) \qquad (E) \qquad [2]$$

where T_S, T_A, T_W refer, respectively, to mean skin surface, air, and wall temperatures, and M and E to metabolism and evaporation. In solutions of the equation the units of the variables as given in Table 1 must be used.

Equation [2] may be applied accurately to any seated-activity situation in which the crude average of air and radiant temperatures is between 50 and 80 F and with air movements of the order of 10 to 20 fpm, with occupants wearing normal male attire, or approximately seven pounds of clothing. In the absence of separate measurements of air and radiant temperature, or in the presence of air movements up to 100 fpm, it may be applied with approximate accuracy. In this latter case the reading of a black globe thermometer should be used to estimate T_0 (the combined T_A, T_W) effect, and the reading of this instrument substituted in both the T_A and the T_W terms of the equation.

Reaction to Extreme Heat[4]

Outside a limited near-comfort range, exposure to heat and cold leads eventually to body damage. The threshold of this injury is generally set by pairs of time of exposure and of body temperatures reached. We consequently find a relationship of safe exposure time or no-damage time and outer environment. Conditions of personal climate, then, do not fall into bearable and unbearable ones but into those bearable indefinitely, or for life, and into those bearable for a certain time, which may range from microseconds to a few years. The human behavior, physiological as well as psychological, resembles rather a chemical rate process with a certain critical margin than a physical process, such as fusion, which does not depend on time but on temperature and pressure only.

Peripheral blood circulation, shivering and muscular activity, and sweating are the main means the body employs to fight effects of cold and heat. All three regulants, temporarily or permanently, may be missing. It is roughly known how they act in a normal man if a certain environment acts for a certain time. All three need time to achieve their goal fully. Exposure to extreme conditions then indicates that these three factors have not been activated before.

Prediction of safe exposure time is of practical interest. Since individual health, sweating, circulatory, skin and other functions, clothing and other protective means are involved, the task of this prediction is difficult. Experimental exposures are the rarer the harsher the conditions are; accident or safe survival reports usually lack critical data such as ventilation, wall temperature, and initial body conditions. The exposure of millions of people to air-raid fires during the war has never been investigated thoroughly with respect to heat transfer, survival times, and medical effects.

Fig. 1 should be judged with these limitations in mind. It describes safe exposure times for any given environmental temperature. The following assumptions are made: Wall and air temperatures are equal; the convective heat-transfer coefficient is that of free convection for the given temperature difference between air and skin which is initially at 35 C; water condensation on the skin is excluded; air humidity is indicated in the graph. Data refer to a man clothed with 1 cm of normal cloth, or nude; in extreme conditions the "nude" curve corresponds to exposure times of unprotected skin areas. A large number of tests and publications went into Fig. 1.

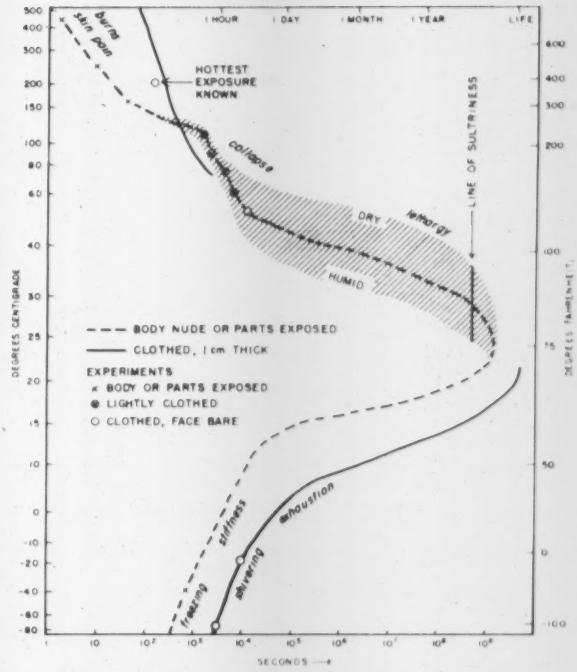


Fig. 1 Safe exposure time for a normal man at rest, and nude or covered with 1 cm of normal clothing. Exposures to the left of the curves are generally safe.

Radiant heat from sources cooler than about 1500 C is nearly completely (in fact, to 97 per cent) absorbed by human skin. The penetration of these radiations through skin and nearly all clothing material is negligible; the only exception known is polyethylene which is fairly transparent up to 20 μ wave length. Metals are excellent reflectors in these spectral regions. Aluminized clothes were mass-introduced by the author during the war as a protection against radiant heat from large fires. They are now a standard item of the fire fighters. White surfaces are better reflectors than metals for radiator temperatures above 2000 C; for example, for sun or for A or H bomb radiation. Of all kinds of heat transfer to man, radiant heat is the easiest to control.

With the exception of visible and near infrared light, radiant heat attacks primarily the same part of the body as all other heat flows; namely, the very surface. We therefore lack a radiation sense and have only temperature senses of different kinds. Most safe exposure time, pain, burn, and similar tests on man are made using radiant heat.

Of the many kinds of actual exposures in the burn-heat area, three are outstanding and subject to mathematical treatment of the ensuing skin temperatures, the step function of heat supply, the contact with a hot body of large capacity and conductivity, and the contact heating through a protective cloth.

With nonpenetrating radiant heat, the test person feels consecutively warm, hot, and unbearably painful. This

[4] Condensed from "Heat Transfer and Safe Exposure Time for Man in Extreme Thermal Environment," by Konrad Buettner, Department of Physiology, University of Washington, Seattle, Wash. ASME Paper No. 57—SA-20.

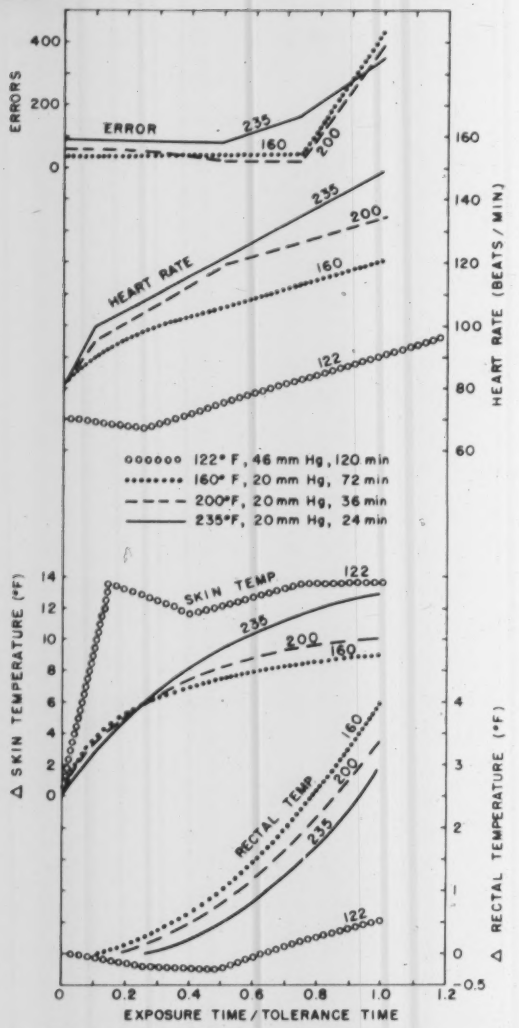


Fig. 2 Physiological body changes and Link-trainer errors in man exposed to warm environments. At value 1.0, the experiment had to stop due to impending breakdown.

latter sensation proved reproducible, and even the depth of the sensation could be localized. The senses report unbearable pain when a layer at 0.1 mm below the surface exceeds 44.8 C.

If this point is exceeded the pain increases sharply, then declines and later disappears. This always indicates a complete burn of the respective skin area. These latter experiments were restricted to small areas of the author's forearm.

For given conditions, such as people at rest in a normal room radiated on the forearm, the prepain time depends in a simple way on the heat supply. The pain point cannot be reached for heat flows below 1200 kcal/sq m/hr because an increase of peripheral blood flow stops, in time, the anticipated further temperature rise.

The ultimate fate of exposed skin is the burn. Burns are actually based on a chemical-rate process; viz., the protein denaturation. Denaturation of deeper layers is probably more detrimental than that of outer layers. Deeper layers usually receive their heat delayed by a conduction process, and even with the penetrating radiant heat from A-bombs the true overheating of the vital skin layers is delayed. Immediate cooling of the afflicted layers with any means, e.g., with the unheated hands, can cause an impending burn to be subcritical. The process of skin denaturation belongs to the most temperature-sensitive rate processes known. Therefore the smallest possible cooling might help.

Naked skin, exposed to less than 1200 Kcal/sq m/hr heat supply or to a calm room of less than 2000 C air temperature, generally can defend itself. We are entering, then, the realm of collapse heat. Times are now so long that precooling plays a minor role, sweating and peripheral circulation a decisive one. The main limiting factors are body temperature and circulation, practically measured by the heart rate. These increases are shown in Fig. 2. The abscissa is the true time of exposure divided by the tolerance or safe exposure time. The human performance as indicated by Link-trainer errors is near normal for the first three quarters of the exposure. During the last quarter, dizziness, faintness, tingling and numbness of the skin, mental confusion, anxiety, blurred vision, and nausea quickly increase until sometimes later a rather startling breakdown occurs. These data are based, mainly, on U. C. L. A. experiments.

Reaction to Extreme Cold[5]

Experiments on physiological responses of the human being to whole-body and local-area cooling (the hand only) have ranged from studies of survival rates of men exposed in ice water, to relatively minor cooling in reduced air temperatures. This investigation is concerned with the individual's ability to perform in cold environment.

Of the two types of generally accepted temperature receptors, i.e., peripheral and central, the physiological responses to cold environment are most probably initiated via the peripheral thermal receptors in the skin. The interaction of these peripheral receptors and the central receptors is complex and poorly understood. It is clear, however, that the physiologic adjustments to temperature are mediated through the hypothalamus.

Immediately on being exposed to cold, there is a general peripheral vasoconstriction manifested by an immediate drop in all of the skin temperatures. The most distal parts of the extremities cool the farthest and the most rapidly while the trunk cools more slowly. The face cools the least of all of the body surfaces. The vasoconstriction that takes place in an experiment of this type is a general autonomic response on the part of the body. The surface temperatures fall not only because the room temperature is lowering, but also because the blood supply to the surface has been reduced (the blood moving inward to protect the vital organs). The peripheral vasoconstriction seen in whole body cooling involves not only the arterial system but also the venous system. This results in a shift in the distribution of blood within the body such that the volume of blood contained in the central organs increases during acute cold exposure.

In addition to the cardiovascular adjustments just

[5] Condensed from "Body Cooling and Hand Cooling," by J. P. Meehan, Assistant Professor, Dept. of Physiology, and H. I. Jacobs, Dept. of Physiology, School of Medicine, University of Southern California, Los Angeles, Cal. ASME Paper No. 57—SA-34.

described, there is also a change in the metabolic heat production of individuals exposed acutely to cold. The increase in metabolic heat production is, for practical purposes, entirely due to shivering. If a person were not confined by the experimental procedure, the shivering could just as well be replaced by voluntary muscular activity.

The application of cold to the hand causes cardiovascular adjustments in the whole body. When the hand is immersed in ice water or exposed to cold in an air box, there is a general whole-body vasoconstriction. This vasconstrictor response to local cooling is a variable matter occurring to greater degrees in some people and to lesser degrees in other people. Such a response to hand cooling is part of the basis for the development of the so-called cold-pressor test primarily designed to select those people with hyper-reactive vasomotor systems. In the cold-pressor test, the extent of the vasoconstriction is measured by an increase in the systemic arterial pressure. Further, if one conducts the hand-cooling experiment and at the same time arranges to record blood flow on the fingers of the opposite hand, he will note that there is a decrease in the finger blood flow in the contralateral hand when the test hand is immersed in the ice bath.

Acclimatization Experiments

The acclimatization experiments take the form of carefully studying a group of subjects under controlled conditions and then restudying the same group of subjects after they have been caused to live in a cold environment, either under actual field conditions or in laboratory cold rooms for a variable period of time. The observations may be summarized generally by saying that the individual who was acclimatized kept his extremities warmer at the expense of permitting the temperatures of the trunk to become colder when exposed to a standardized whole-body cooling experiment.

To date, physiologic studies have failed to reveal any parameter that can be assigned the role of the basic determinant of individual differences in response to cold. Short-term acclimatization studies offer meager evidence of adaptive physiologic changes. Although the response of an individual to various cold-exposure tests can be altered by subjecting that person to prolonged cold exposures over a number of days, there is no common physiological parameter to which this change in response can be attributed.

It is possible that the acclimatization we see may be on the basis of changes in the subject's cortical interpretation of the cold stimulus with subsequent modification of the autonomic responses elicited by the stimulus. The average resident of the more temperate climates is relatively inexperienced with regard to exposure to severe cold. Such exposures are new and can evoke a profound autonomic reaction on the part of the individual. Familiarity with the stimulus along with learning that he has the ability to get along in cold may change the individual's initial response to sudden cold exposure.

For example, consider the subjective response of the Eskimo to the hand-cooling experiments previously described. As anyone who has done this experiment will know, immersion of the hand in ice water for a period of 30 min is, indeed, a painful experience. The majority of Caucasian subjects will complain, some quite bitterly, of the pain experienced during the test. In conducting the study on Eskimos, however, a fair number of them would fall asleep for the duration of the experiment while their hands were immersed in the ice water. It would be difficult to argue that the Eskimo wasn't receiving the same peripheral stimulus as was the white subject. In studies of pain thresholds of these same natives, it was found that they were not different from Caucasian subjects.

An altered emotional state may entirely change the response of a subject to cold exposure. Hand-cooling experiments were being conducted in the laboratory on a small group of subjects, and repeated observations had been made on one subject in particular. On one occasion he came into the laboratory after having completed an examination over which he was quite disturbed. He stated that he was in a state of tension and even after the usual equilibration period before starting the experiment, he was still quite agitated. On three previous runs, this subject had given essentially normal response. On the day in question, however, he failed to exhibit any rewarming at all, and the hand cooled to bath temperature and stayed there for the full half hour. During the experiment he complained bitterly of pain in the cooled hand. The hand remained painful for several hours after the experiment and as a result of this experience, the subject refused to participate in further studies. This is a good example of how emotional state can modify the response of the individual. It is apparent that the subject just mentioned would have been considerably handicapped had he been required to perform manual tasks in a cold environment in his emotional state at the time of his last experiment.

Exposure to Infrared Radiation[6]

RECENT studies of the changes in skin temperature occurring during exposure to thermal radiation have permitted estimations of the "thermal inertia" of the skin and of the measurement of the temperature end point for threshold cutaneous pain. The methods employed in these investigations required blackening of the skin surface and exposure to relatively intense radiation. Under these conditions, vasomotor and other responses of the skin are found to cause a variability in the skin's thermal inertia; in addition, there may be some influence of the blackening material upon the heating of the skin. It was therefore proposed to study the small temperature changes occurring when the skin is exposed to long-wave, nonpenetrating infrared radiation.

The present problem required the solution of the heat-flow equation under the following assumptions: The skin is considered as the surface of a thermally homogeneous layer through which there is initially a constant heat flow from the core of the body to the skin surface and thence into the environment through a surface layer of air. The heated area is assumed to be so large that there is no lateral heat flow in the area under consideration but flow only down the linear gradient perpendicular to the skin surface. The core temperature is assumed to be held constant by the flow of blood, and the skin temperature to have an initial value which is higher than

[6] Condensed from "Measurement of the Heating of the Skin During Exposure to Infrared Radiation," by E. Hendler, Air Crew Equipment Laboratory, U. S. Naval Air Materiel Center, Philadelphia, Pa.; R. Crosbie, and J. D. Hardy, Aviation Medical Acceleration Laboratory, U. S. Naval Air Development Center, Johnsville, Pa. ASME Paper No. 57—SA-33.

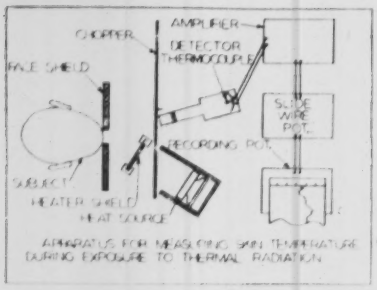


Fig. 3 Schematic diagram of the apparatus used for irradiating a test surface and simultaneously measuring its temperature. The heat source was a circular electric hot plate, its temperature maintained at 250 C. The face shield was of asbestos.

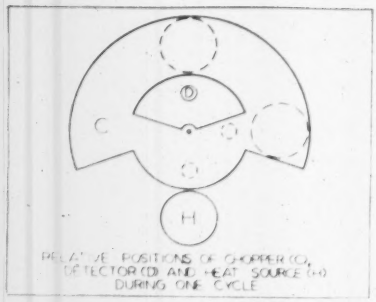


Fig. 4 Diagram of the double chopper, showing relative positions of the chopper (C), detector (D), and heat source (H) during one cycle (solid circles exposed; dashed circles occluded). Heater and detector are never exposed at the same time.

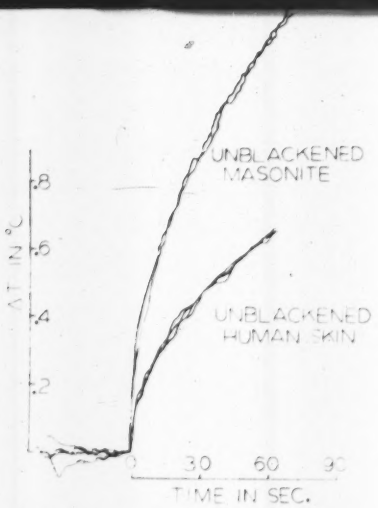


Fig. 5 Recordings of six heating curves of the skin, and two of masonite, with exposures to 2.65 mcal/sec/sq cm radiation intensity

the ambient temperature. The blood flow and the heat production per unit volume in the outer layer are assumed to be small. Thus there is thermal equilibrium initially with the same quantity of heat flowing into and out of the gradient layer.

(The authors develop heat-flow equations to determine the temperature at any depth in the layer as a function of the time after the start of irradiation.)

It is doubtful whether completely accurate boundary conditions can be stated for the problem involving heat flow into the living skin, or whether, even if actual boundary conditions could be stated, an exact mathematical solution would be forthcoming. It must be recognized that the skin is not a metabolically inert, thermally homogeneous solid with a linear thermal gradient across it in which there is no lateral flow of heat.

Method

The apparatus used for irradiating and measuring the temperature of test surface simultaneously is shown diagrammatically in Fig. 3. All of the components were rigidly mounted on a heavy stone-topped table. A circular electric hot plate having a diameter of about 12 cm served as the heat source. The heater was thermally shielded and positioned so that its maximum radiation was directed toward the test surface. The heater temperature was monitored with a copper-constantan thermocouple and during experiments was maintained at about 250 C. A vertically sliding heater shutter separated the heat source from the test surface. The position of the heater shutter was continuously adjustable and could be manipulated to determine both the extent and duration of test-surface heating and subsequent cooling. An asbestos face shield containing a circular aperture of about 37 cm^2 was used to position the test surface during the experimental procedure and also the blackened cone of a Leslie cube, which was used for calibration purposes. Measurements of the distribution and intensity of radiation in the area enclosed by the face-shield aperture showed that local intensities measured in the periphery of each quadrant and in the center of the aperture differed by less than 3 per cent from the average intensity. The magnitude of applied radiation was between 2 and 3 mcal/sec/cm^2 and was measured in all four quadrants of the aperture at the beginning and end of each observation. About an hour was required for the radiation source to warm up and reach equilibrium.

Seated subjects were positioned so that a central area of the unblackened forehead was exposed through the face-shield aperture. Care was exercised to insure that only nonsweating subjects in thermal equilibrium with normal room temperatures (20–25 C) were used. The unblackened surface of a block of masonite approximately 0.6-cm thick also was used as a test surface.

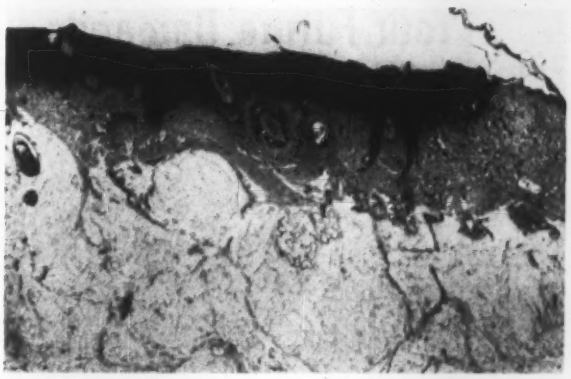
An especially designed metal chopper revolving about 12 times per sec interrupted both the radiation emitted by the heat source and that emitted by the test surface. The chopper was constructed of sheet aluminum, cut to the shape shown in Fig. 4, and concentrically balanced around the axle on which it was mounted. Circular areas representing the heat source and detector-tube opening are shown projected onto the chopper at selected instants during one chopper revolution in Fig. 4. The peripheral area of the chopper interrupts the radiation exchange between the heat source and the test surface, while the central chopper area interrupts in an opposite phase the radiation exchange between the test surface, and the detector. Thus, the cut-out areas of the chopper are so arranged that heater and detector are never exposed to the test surface at the same time.

The central portion of the chopper was covered with polished silver to minimize radiation exchanges between chopper and detector caused by changes in chopper temperature. When the chopper itself was heated by holding a hot soldering iron near it, no change occurred in the record. Deflections were proportional only to the radiation exchange between detector element and test surface.

(Results of the tests are tabulated, showing the thermal inertia for surface heating of unblackened human skin, and comparison tests on unblackened masonite.)

Results

Typical heating curves for the test surfaces studied here, namely, unblackened masonite and human skin, are shown in Fig. 5. Examination of these curves shows the reproducibility of the results obtained with the apparatus, as well as the qualitative difference in the



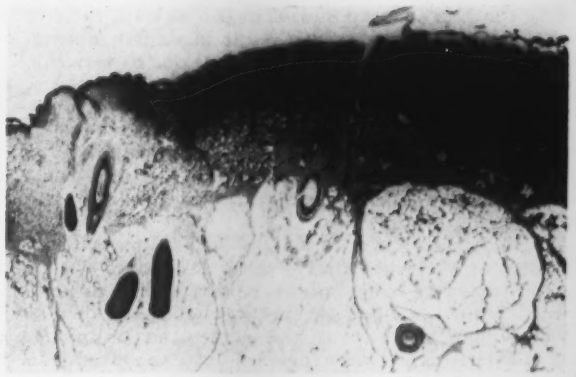


Fig. 6 Photomicrographs of burned porcine skin. *On the left,* radiant exposure 16 cal per sq cm; exposure time, 0.5 sec. The burn (black area) appears dehydrated and compressed, but does not extend through the full thickness of the skin. *On the right,* radiant exposure 16 cal per sq cm; exposure time, 10.0 sec. The burn, which is not dehydrated or compressed, extends through the full thickness of skin and into the subcutaneous fat.

thermal properties of masonite as compared to human skin. The relatively rapid increase in surface temperature of the masonite as compared to that of the skin is indicative of its relatively low thermal inertia.

Limitations of the heat-flow equations make predictions of skin heating an empirical phenomenon that must be investigated experimentally for each condition.

Histolic Studies of Burns[1]

The atomic bombings of Japan demonstrated how important it is, from both military and medical standpoints, to be able to predict heat flow through tissue and thermal damage to tissue. About 90 per cent of the Japanese who sought medical aid within the first week after the bombings did so because of thermal burns, and in Hiroshima alone there were 70,000 such casualties.

"Punishment Integral"

Predictions of the severity of injuries which might be sustained by one's own troops or of those which would be inflicted on the enemy are dependent on knowledge of the response of skin to exposure to various quantities of thermal energy. About 10 years ago, Henriques and Moritz determined the histologic effects of low-temperature, long-exposure, contact burns. Their "punishment integral" has subsequently been used to predict the depth of damage from a given energy input, the median effective exposure for various levels of damage, and the differences to be expected from various input pulse forms.

The use of the punishment integral requires one to assume that a given quantity of energy will always be more destructive if it is delivered during a short exposure time than if delivered over a longer period of time. The same quantity of energy will result in a higher temperature with the shorter exposure. Thus the skin is treated as a passive receiver. There is no provision for the possibility that the skin might react differently to different temperatures and that the type of reaction might influence the severity of the burn.

This paper, based on the histologic demonstration of radiant-thermal-energy damage to tissue, points out some of the reasons why any damage equation which treats the skin as a uniform passive receiver must have a very limited application.

Experimental Methods

The experimental animals were young Chester White pigs anesthetized with intraperitoneal Dial with urethane (Ciba) in doses of 70 mg per Kg of body weight. These animals have skin very like that of humans. The hair was removed with electric clippers and the skin was gently washed. The heat source was a modified 24-in. army carbon-arc searchlight which permits accurate control of the radiant exposure and exposure time.

Eighteen to 24 hr after the burns were placed, biopsies were taken across the injured areas so that normal tissue was included on each side of the burn. The biopsies were fixed in 10 per cent formalin, embedded in paraffin, and stained by a method which has been described for the differential staining of burned and normal tissues. The depth of damage was measured with the aid of a ruled ocular in the microscope, and a comparison was made between the percentage of thickness of the skin burned and unharmed.

Results of Tests

The results from microscopic assessment of the 5-cal-per-sq-cm burns show that, at this exposure level and within the times investigated (0.5 sec to 30.0 sec), the severity of the injury decreases as exposure time increases. This finding merely confirms in another manner an earlier observation that increasing the exposure time necessitates an increase in the total energy input in order to produce burns of equal severity.

In the case of the 16-cal-per-sq-cm burns, contrary to the 5-cal-per-sq-cm burns, the most severe injury does not occur with the shortest exposure time. The extent of damage is essentially the same with the 0.5 and 30.0-sec exposures, but the energy has been more destructive with the 5.0 and 10.0-sec exposures.

At 10 cal per sq cm, radiant exposure, with a square pulse, does more damage if delivered in 3.0 sec than it does if the exposure time is either 0.3 or 10.0 sec. The simulated atomic-bomb pulse perhaps causes less damage

[1] Condensed from "Histolic Studies of Some Reactions of Skin to Radiant Thermal Energy," by J. R. Hinshaw, University of Rochester School of Medicine and Dentistry, Rochester, N. Y. ASME Paper No. 57—SA-21.

during the 12.65-sec exposure than it does with the two shorter times, both of which result in similar injuries. However, there is no marked difference due to variation in either pulse shape or exposure time.

The effect of a given quantity of radiant thermal energy depends on the exposure time, but the most effective exposure time for one dose is not necessarily the most effective for another. Within the time limits investigated, 5 cal per sq cm do the most damage during the shortest exposure time.

A damage-prediction formula which assumes that a quantity of energy is always more destructive with a shorter exposure time might be applicable to mild burns. When, however, higher irradiances are used to produce more severe burns, the factor of exposure time works differently. Under these conditions, a given radiant exposure does not necessarily produce maximum damage when delivered in the shortest possible time. When the energy input is in the form of a square pulse, 10 cal per sq cm are more destructive if delivered in 3.0 sec than if delivered in either 0.3 or 10.0 sec. Similarly, 16 cal per sq cm are more destructive with exposure times of both 5.0 and 10.0 sec than with times of 0.5, 1 0, and 3.0 sec. It is particularly noteworthy that the 10.0-sec exposure is more destructive than the 3.0-sec one with 16 cal per sq cm, but the reverse is true with 10 cal per sq cm.

The Steam Bleb

A probable reason for these differences may be inferred from gross and microscopic examinations of the burns. The 16-cal-per-sq-cm exposure will illustrate this. When this quantity of energy is delivered to the skin in 0.5 sec, a steam bleb is produced. The steam bleb represents a violent surface reaction; the water in the superficial layers of the skin is converted to steam. There is, thus, an abstraction of heat, or a diversion of energy from the deeper tissues. The microscopic appearance of these burns is that of severe dehydration of, and damage to, the superficial layers, Fig. 6, *left*. If the same quantity of energy is delivered with an exposure time of 10.0 sec, a steam bleb does not form. Temperatures high enough to convert tissue fluid into steam do not obtain, and there is no similar abstraction of energy. A deeper burn which does not show severe dehydration and compression of the superficial tissues results from this exposure, Fig. 6, *right*.

Steam-bleb formation is only one reason why damage-prediction equations which treat the skin as a uniform, passive receiver cannot be widely applicable. Of particular importance from the medical standpoint is the fact that damage to the epithelium of the hair follicles is always deeper than is damage to the dermis. Analysis of the microscopic appearance of the burns indicates that radiant energy penetrates more deeply via the hair shafts than it does through the dermal collagen. It is also possible that temperatures not great enough to destroy dermal collagen will, nevertheless, lead to irreversible damage of the epithelial cells. Whether or not a large area burn can heal without a skin graft is primarily dependent on how many deeply located epithelial cells survive the thermal insult. From the practical point of view of being able to predict the extent of injury, the depth of injury to the hair follicles is more meaningful than is the degree of damage to the other tissues of the dermis.

Your Future Demands...

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS has appropriated $10,000 to help defray purely preliminary expense for "A Survey of the Engineering Profession." Other societies have also made contributions so that Engineers' Council for Professional Development and Engineers Joint Council now have a fund of $50,000 with which to scratch the surface of the proposed survey.

What is the object of the survey; what will the survey accomplish; and why was such a substantial sum appropriated by ASME for its initiation?

Nobody knows, even approximately, what the final survey will cost, how long it will take, who will make it, or who will pay for it! All that is known is that such a survey is essential to our survival as a profession. We are bursting at the seams, and will fly apart if we do not diagnose some of our problems and adopt remedial measures. Within the limits of the $50,000 budget it is hoped that the scope of an effective survey and an estimation of its cost can be defined. Ability to forecast the potential benefits not only to the profession, but to the national economy and to the welfare of mankind are also hoped for. It is certain that the resulting benefits can be shown so clearly that some great Foundation will be justified in financing the survey itself.

The Joint ECPD-EJC Committee on "A Survey of the Engineering Profession," reported in September, 1956, that:

> Critical problems have arisen in every facet of the profession: Education, utilization of manpower, organization, and social and economic factors, all of which intimately concern the national welfare.
>
> The ever accelerating pace at which expanding scientific knowledge and discovery are rendered useful by the engineer has stimulated a world-wide revolution. By force of momentous advances that are still in progress, the engineering profession has assumed broad responsibilities, among which its traditional concern with individual professional competence is only one. The engineering profession today is the most complex of all. The present shortage in engineering manpower, serious enough by itself, has served further to underscore many other major problems confronting the profession. It has raised more questions than have been answered.

The survey is expected to answer many of those

Based on an address delivered at the President's Luncheon during the Fall Meeting, Hartford, Conn., September 22–25, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEER.

the Engineering Profession

Engineers lack the group consciousness and prestige of the medical profession which have resulted in large degree from the 1910 survey of that profession. Clear understanding of the educational requirements, function, and proper organization of the engineering profession is vitally needed, and is the purpose of the survey for which preliminary studies have been initiated.

By William F. Ryan, President, ASME

Medical Profession as a Precedent

The precedent for the survey, and the underlying reason for confidence in its value, is the momentous survey of the medical profession conducted by Abraham Flexner, nearly 50 years ago.

In contemplating professional problems, the medical profession is always cited as an ideal. Doctors have an unexcelled technological education; they have a central and unifying organization; they have a code of ethics, strictly enforced, known and accepted not only by themselves but by their clients, politicians, the armed services, and the general public. Engineers have a Code of Ethics not only unknown to the public, but scarcely known to themselves. Doctors have an undisputed legal status. Engineers have a legal status on the law books, but it is rejected by a majority of engineers. Doctors have that highly developed group consciousness, so vital to genuine professional status. Most important of all, they know who is a doctor, and also what a doctor does.

Perhaps when the survey of the Engineering Profession is completed, engineers will know who is an engineer and what he does. If you think you know, write out the answers and show them to another engineer! Even the old saw that "an engineer is a person who does engineering" and "engineering is what an engineer does," won't satisfy the equation. It would be more appropriate to say that "engineering is what an engineer ought to do."

As a profession, engineers may well admire and envy doctors, but the American medical profession was not always what it is today. When Abraham Flexner made his famous survey less than 50 years ago, the condition of the medical profession was a scandal. An incredible number of medical schools were little more than rackets, operated for the private profit of the teachers. There were no entrance requirements, no real laboratories, no libraries, and no definite standards for graduation. The idea was to have as many students as possible, collect the tuition fees, and divide them. Incredible? Read Flexner's book, "Medical Education in the United States and Canada," published in 1910, and his autobiography published in 1940! Equally incredible are the methods which Flexner had to adopt to get the facts. For 3000 years doctors had possessed that group consciousness which engineers so sadly lack; even the most righteous and ethical among them were reluctant to disclose the shortcomings of their fellow practitioners to Flexner, because he was not a doctor! He received later numerous honorary MD's for services to the profession, but he never studied nor practiced medicine.

If you believe that our problems are too complex or too difficult to remedy, observe the vigor and speed with which the medical profession cleaned house, once the facts were laid before them.

The number of medical schools in the United States when Flexner made his report was 255, of which only one, in Flexner's judgment, was in a class with the better medical schools in Europe; 170 of them; which would now be described as rackets, were sunk without a trace. The remaining 85 schools were strengthened and consolidated, so that the total number was reduced to 35. In just a few years American medicine rose from the lowest to the highest place among the countries which comprise Western civilization.

The medical profession's rise to its present place of high esteem dates from the survey in 1910!

Now, a trained nurse, after working in close association with doctors for many years may acquire much knowledge and skill, but she does not undertake the practice of medicine. If she aspires to be a doctor she goes to medical school, serves an internship, and gets her license to practice from the State. Neither does a biochemist, who has developed a vaccine, start to practice medicine even in the limited area to which his vaccine applies. Contrariwise, a doctor knows what *his* job is, and he does it. He does not make routine analyses in hospital laboratories. He does not develop x-ray films, roll pills, or mix medicines. He never does anything which a properly trained technician can do for him.

From your own experience, would you say the same is true of an engineer? Perhaps when our survey tells us who is an engineer and what he does, and we undertake to let him do it, we will find that the shortage of engineers is not so great as we had feared.

Engineering Education

While the American doctors' instruction in medicine was deplorable in 1910, American instruction in engineering is the best in the world, although that statement will be challenged even by engineering educators.

Your Future Demands...

Engineering education in this country can be better and will be better, but for a hundred years America has led the world in that field.

One of the world's keenest observers and finest reporters, The Right Honourable Sir Winston Churchill, speaking at the Mid-Century Convocation of M.I.T. in 1950, paid a tribute to American engineering schools in the following words: "We have suffered in Great Britain by the lack of colleges of university rank in which engineering and the allied subjects are taught. Industrial production depends on technology, and it is because the Americans have realized this and created institutions for the advanced training of large numbers of high-grade engineers to translate the advances of pure science into industrial technique, it is for this reason that their output per head and consequent standard of life are so high."

Winston Churchill knew who put radar on a production basis, with equipment designed for effective use by ordinary soldiers and seamen, and thereby saved his country from destruction. He knew who performed the gigantic task of producing fissionable material in sufficient quantity for atomic warfare, and thereby ended the war.

Churchill knew that American engineers furnished the margin between victory and defeat, not only in the traditional areas of military supply, but in the newer developments of electronic and nuclear science. As he phrased it, we translated "the advances of pure science into industrial technique."

Science still drops advances into the laps of the engineers at a staggering rate, and educators have a tremendous task in preparing future engineers. Today the mechanical engineer should know the principles of nuclear physics and be proficient in electronics. In the near future a competent engineer will have to be as familiar with electronic computers as he is now with the slide rule. Student sections complain universally about the rigors of their curricula. They can thank their Maker that they are getting their degrees now and not in 1967.

Few of us have faced the fact that we cannot do what we hope to do in engineering education in four-year curricula. There is no room, even in high school, for any modern language except English. No time is available for the humanities and social sciences which professors say their students lack; and still the curricula provide inadequate training in physics and mathematics! Perhaps the survey will show how to do all that is said to be required in four years, and at the same time prepare engineers to hold commissions in the armed services; but more probably it will disclose the necessity of a radical revision of the basic plan for engineering education.

Since Flexner's survey was completed, undergraduate instruction in medicine has disappeared. Is that the solution for engineers? Should an engineer first earn the AB degree, majoring in mathematics and natural science but with a really effective grounding in the humanities and social sciences, and then go on to a master's or doctor's degree in engineering? Perhaps a master's degree in engineering and a doctor's in mechanical engineering are required to give us the kind of an engineer educators visualize. On the other hand, we may not need many such engineers. The survey will tell.

Group Consciousness

Education, at least education in technology, is not our greatest problem. The most serious failure has been the lack of group consciousness among engineers. Why do less than half of all practicing engineers in the United States belong to any engineering society? Why do so few of those who do belong take active parts in their affairs? Why have we only a handful engaged in furthering the professional aspects of engineering? Why have less than a third of them accepted the professional identification of registration? Why do engineers ask in Section meetings: "What do you mean by ECPD?" "Why does ASME belong to EJC?" "What is the purpose of EJC?"

- Why do engineers join trade unions?
- Are engineers adequately compensated?
- Are our engineering educators adequately compensated?
- After stimulating a material increase in enrollment of students in engineering curricula, are we in danger of finding that we have no one to teach them?
- How can we make rhyme or reason out of our misbegotten conglomeration of registration laws?
- How can we create a genuine legal status for engineers?
- How can we develop the auxiliary forces that an engineer needs for the efficient use of his talent?
- How can we induce women to enter our ranks, and how can we employ their talents efficiently?
- How can we arrest the proliferation of engineering societies, and how can we eliminate competition, duplication of effort, and even conflict among them?

Organization

The great question is organization.

If you were to prepare an organization chart of the engineering profession as it now exists, you would agree that it would be a good organization for a rabbit warren inhabited exclusively by two-headed rabbits; whereas an organization chart for the medical profession is so logical and efficient that one would suppose it had been designed by engineers. We have in being an almost exact counterpart of the American Medical Association. More than 80 per cent of the doctors belong to AMA. Why do less than 10 per cent of the engineers belong to the National Society of Professional Engineers?

Perhaps all of our problems, including organization, stem from faulty professional education. If engineers came out of engineering schools as well grounded in professional concepts as they are in technology, solutions might be automatic.

That, too, is a problem for the survey.

It will be some time before significant progress can be reported on the Survey. ECPD and EJC have engaged a competent organization to undertake what might be called a "preliminary, preliminary survey," and their report is expected at an early date. In the meantime, every member of ASME should take an interest in the survey from its inception and co-operate in any way possible.

VACUUM METALLURGY

The "Age-Old Art of Brazing," combined with vacuum techniques, produces new structural materials for corrosive-chemical containers and for high-temperature flight

By R. C. Bertossa

Stanford Research Institute
Menlo Park, Calif.

THE metals-fabricating picture has been complicated by new demands from engineers in the aircraft, missile, and atomic-energy fields—and the petroleum industry, as well—for materials capable of withstanding high temperatures and corrosive environments.

Titanium, zirconium, tantalum, columbium, and molybdenum all have exceptional properties which make them desirable for use in newly developed processes and industrial equipment where requirements are too severe for ordinary metals and alloys.

However, these metals have one common undesirable characteristic: They are easily embrittled at elevated temperatures by contact with even small quantities of atmospheric gases such as oxygen, nitrogen, and hydrogen. In addition, they suffer very rapid deterioration through oxidation at those temperatures.

The use of vacuum techniques in melting, heat-treating, and joining (including cladding) not only protects against contaminating gases, but also promotes the removal of gases and other impurities from metals previously contaminated. This latter characteristic of vacuum metallurgy is termed "out gassing."

The aircraft industry is faced with the problem of using metals in service ranges of 2000 to 3000 F in propulsion units and missiles. It is quite possible that vacuum-melting techniques will allow the development of a new high-temperature alloy which will exhibit satisfactory strength at these temperatures and have satisfactory oxidation resistance in atmospheric gases. In the meantime, however, another channel of research is being followed in an attempt to use present high-tem-

Contributed by the Metals Engineering Division and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9-13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 57—SA-95.

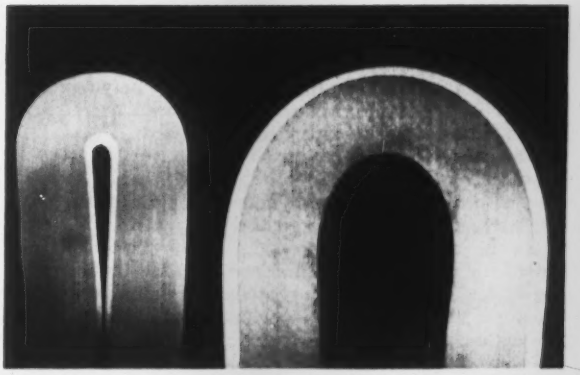


Fig. 2 Cross sections of 180-deg bend tests on ordinary vacuum-pressure-clad steel, demonstrating the continuity and strength of the bond. The sections have been polished and etched. Corrosion-resistant metals are vacuum bonded to the base metal as a flat plate which can then be formed into shapes and welded.

Fig. 3 Vacuum-clad steels are a new industrial material. This vacuum-pressure-clad 91-ft tower is made of carbon steel to which monel has been vacuum bonded. Additional metals which have been clad to steels successfully by vacuum techniques are: titanium, zirconium, tantalum, molybdenum, silver, gold, platinum, aluminum-bronze, copper, lead, and beryllium-copper.

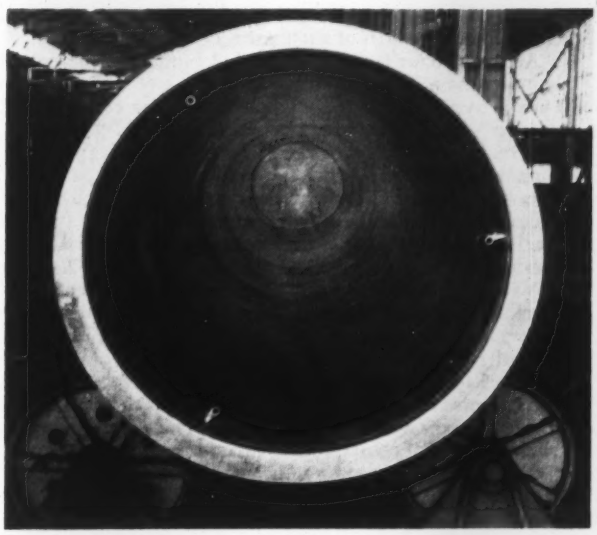


Fig. 1 An experimental pressure vessel for chemicals so corrosive they could be contained only by noble metals such as silver, gold, and platinum. High-vacuum brazing permitted 1/16 in. of fine silver to be integrally and continuously bonded to 1 in. of austenitic stainless steel. This experimental vessel proved the practicality of silver-clad steels for the chemical industry.

perature metals to greatest advantage. This phase involves the development of oxidation-resistant claddings for metals such as molybdenum, tungsten, tantalum, columbium, and others, in order that they may have protection in high-temperature service while their exceptional high-strength properties are utilized.

Vacuum cladding appears to present the greatest potential for solution of this problem, and research on it is now in progress at Stanford Research Institute and other high-temperature metallurgical research centers.

In the chemical industry, advanced process designs called for process and containment vessels to withstand variations between high positive pressures and partial vacuums at elevated temperatures. The chemicals involved were extremely corrosive and could be contained only by certain noble metals such as silver and gold.

The solution appeared to be a continuously bonded, high-strength clad layer of noble metal on less expensive backing materials such as carbon steels or stainless steels. Discontinuously bonded noble-metal liners had been tried and proved unsatisfactory in that heat, and pressure variations while the vessels were "on stream" caused failures in the noble metal liner, which in turn allowed highly corrosive liquids to contact the backing steels.

An initial experimental vessel over 20 ft in length, with $^1/_{16}$ in. of fine silver integrally and continuously vacuum bonded to 1 in. of austenitic stainless steel, was produced, Fig. 1. The technique used was an adaptation of the patented "Hortonclad" vacuum-cladding process for producing high-strength clad plates for subsequent fabrication into pressure vessels.

The Hortonclad process is, in essence, a method of cladding one or more metals on another similar or dissimilar metal, using selectively applied high vacuum at the bonding interface during the entire bonding and heat-treating cycle. Since the vacuum is drawn only on the central area of the assembly where actual bonding is to take place, an expensive vacuum furnace is not required, and the outside atmosphere is utilized to attain highest strength and uniformity of bond by causing it to be exerted on the assembly or "pack" at elevated temperatures.

Atmospheric pressure is aided by increased atomic mobility of the parent metals at elevated temperatures to gain optimum bonding interface conformity. The resulting clad plate can be bonded effectively over areas of 1000 sq ft or more in one operation, and meets ASTM-ASME specifications for clad plate for pressure-vessel use. It subsequently can be formed into shapes and welded by ordinary techniques for welding clad metals.

The initial noble-metal clad vessel produced for chemical service proved satisfactory and made the use of silver-clad steels practical and economical.

Industrial Applications

Lest the impression be created that this technique is applicable only to unusual metals and designs which can be produced in no other manner, attention is called to commercial operations in which corrosion-resistant metals are vacuum clad to ordinary steels. There are large vessels now in chemical, petroleum, and paper-pulping service, fabricated from vacuum-clad stainless steels, monel, nickel, and inconel. All these materials are applied on inexpensive low and medium-carbon steel backings. Fig. 2 shows test bends, illustrating the continuity and strength of such vacuum bonds.

A tower made from vacuum-clad plates for the petroleum industry is shown in Fig. 3.

In a hypersonic wind tunnel now under construction on the West Coast, intricate webs of liquid-flow channels had to be built into the walls $^1/_4$ in. from the inside tunnel surface. These channels were to dissipate heat to avoid warpage in the tunnel structure which would cause distortion of air-flow patterns. A new type of steel plate containing a network of channels had to be produced.

Vacuum-brazing techniques solved this problem. An intricate pattern of grooves was machined into a flat plate, and then another flat steel plate was vacuum brazed over the grooves, Fig. 4.

Fig. 5 is a photograph of an x-ray negative which was used to examine the continuity of bond in the area where a viewing port will be installed. This photograph shows the quality of high-strength vacuum-brazed bonds.

When higher speed requirements for aircraft necessitated change-overs from aluminum to stainless steels in airframe and skin construction, higher density metals

Fig. 4 Liquid-flow channels for the wall of a hypersonic wind tunnel. Grooves were machined into one plate, and another plate was vacuum brazed over the grooves. In this process, a vacuum created within the multimetal assembly eliminates contamination. Outside atmospheric pressure forces the bonding surfaces together, resulting in a uniform, high-strength braze. For this cooling plate, stainless steel was bonded to carbon steel.

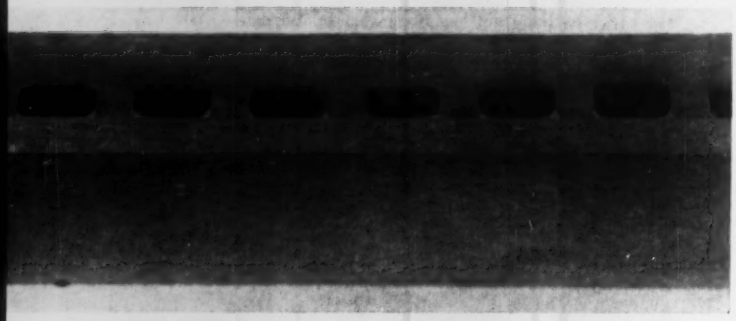
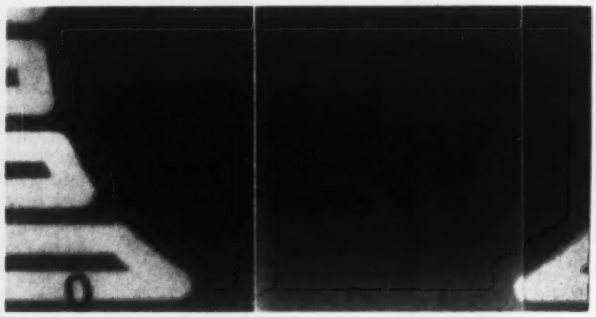


Fig. 5 Photograph of an x-ray negative which was used to examine the continuity of bond in an area of the wind-tunnel wall where a viewing port would be installed. In this vacuum-pressure brazing, the vacuum is drawn only within the assembly, where actual bonding is to take place. Hence an ordinary heat-treating furnace can be used. X-ray shows a sound, continuous bond.



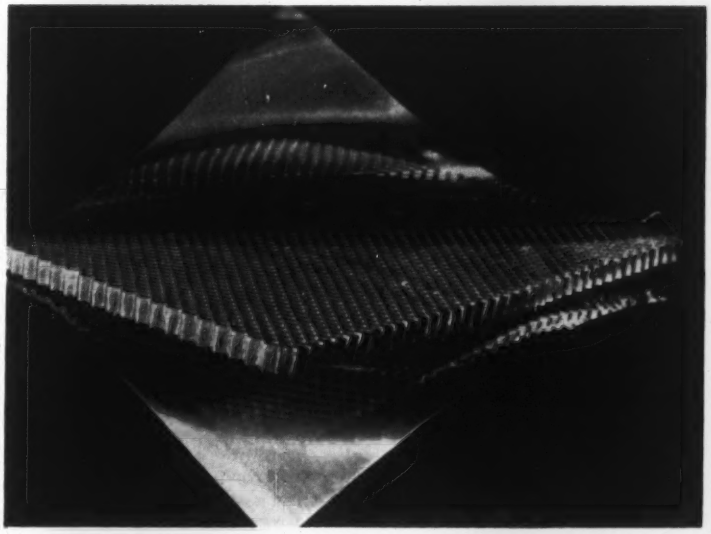


Fig. 6 Experimental stainless-steel honeycomb section (Solar Aircraft Company). Thin stainless sheets are brazed into honeycomb sections of various designs to produce lightweight structures of great rigidity and strength. The changeover from aluminum to stainless steels in high-speed, high-temperature airplanes demands such new structural elements. Vacuum-brazing techniques will play their part in the transition to commercial production, making possible strong, uniformly brazed sections.

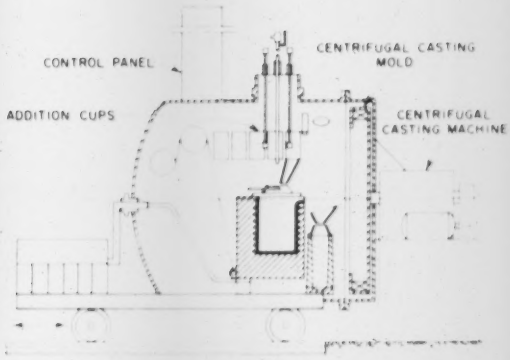


Fig. 7 Cross section of a 1000-lb high-vacuum furnace, in closed position. The 9-ft-long melting chamber becomes sealed when the carriage, moving to the right, brings it against the cover which contains the casting mold. Great areas for additional productive research exist in the field of vacuum melting, joining, and heat-treating.

had to be designed to allow maximum structural strength with an absolute minimum of weight. Aircraft engineers came up with the brazed, so-called honeycomb structural sections, Fig. 6, in which thin stainless sheets are used to produce a light-weight section of great rigidity and strength.

The brazing problems here are increased by the necessity for brazing intricate shapes made of thin sheets. This is a process which is as yet in the development stage; however, it is predicted that vacuum-brazing techniques will play an important part in solving the problems of transition into commercial production. The ability consistently to produce strong, uniformly brazed honeycomb sections of various designs on a production basis will mark an important milestone in aircraft-engineering progress.

Summary

The following characteristics and advantages of vacuum-metallurgical techniques illustrate how well suited they are for handling high-temperature metals:

1 High vacuum effectively excludes atmospheric gases during the time the metal is at elevated temperatures.

2 It can actually break down and remove oxide films previously built up on certain metals, cleaning and deoxidizing the surfaces of the metals.

3 Many nonmetallic, some metallic, and most gaseous impurities are scavenged from metals, upon both vacuum melting and heating under vacuum without melting.

4 In brazing of metals, vacuum techniques exclude oxidation from the interfaces, allowing uniform and complete bonding without fluxes. Vacuum can be used also to exert very high uniform pressures on the bonding interfaces, bringing them into intimate contact and thus insuring a uniform cross section of bond and highest joint strength with a minimum of brazing alloy.

5 In all operations, vacuum methods produce products which are bright and clean and, in many cases, need no further finishing prior to marketing.

It should be brought out that many of the more common metals, such as stainless steels, carbon steels, and nonferrous metals produced by ordinary methods have proved unreliable for newer process applications in which optimum properties, with small allowance for safety factors, are required. The metals, produced by ordinary production practices, normally contain defects such as segregations of nonmetallics, voids, entrapped hydrogen, and other gases. When these defects and impurities have been removed by vacuum-melting and/or heat-treating, these common metals and alloys show remarkable increases in strength and other desirable properties. Vacuum-melted common metals are now gaining in use, since, for an increase in cost of but a few cents per pound, metals of much greater homogeneity and much better properties can be obtained.

On the other side of the ledger, handling problems in vacuum metallurgical work is somewhat complicated—equipment is intricate, Fig. 7, and skilled meticulous operators are required to produce, heat-treat, join, and decontaminate the metals. These particular problems are being resolved rapidly. Many commercial vacuum-melting, heat-treating, and joining units are now in successful operation, and it can be said that the technique is now becoming an important modern industrial tool.

Acknowledgments. Chicago Bridge & Iron Company (Hortonclad Division), Birmingham, Ala.; Jet Propulsion Laboratory, Pasadena, Calif.; Utica Drop Forge Company, Utica, N. Y.; Solar Aircraft Company, San Diego, Calif.; Westinghouse Electric Company, Sunnyvale, Calif.; Office of Naval Research, Navy Department, Washington, D. C.; Standard Oil Company of California, San Francisco, Calif.; Haynes Stellite Company, Kokomo, Ind.; Fansteel Metallurgical Corportaion, North Chicago, Ill.

By R. A. Wilson

Chief Engineer, The Galigher Company, Salt Lake City, Utah

Belt Feeders

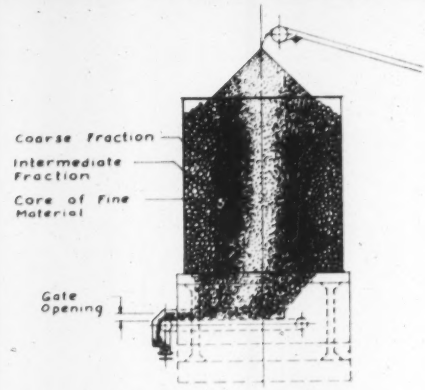


Fig. 1 Slot-type belt feeder

The long tapered slot in a typical slide-plate-type belt-feeder hopper tends to make the entire bottom of the bin "live," providing an effective blending within the bin itself, by reclaiming the bin contents across the major bin width. This is particularly advantageous with ore, since it tends to segregate into fine and coarse fractions when discharged into a storage bin. The slot-type belt feeder, Fig. 1, reclaims the bin contents and blends the segregated fractions.

The long slot also provides the least chance for arching across the feeder opening, a disadvantage of circular or square bin openings which tends to stop feeding.

The circular or square opening also increases material segregation by providing a point draw-off which usually concentrates one fraction or the other, sometimes alternately, during the operation. This causes variations in size, assay value, grinding characteristics, and metallurgical response to process steps.

Slot-type belt feeders have been manufactured in two different designs, the slide-plate type, and idler type, with both flat and troughed idlers. The basic design considerations are relatively simple, and easily applied.

Basic Design Considerations

First, the weight of the ore supported by the belt on this type of feeder can be determined with sufficient accuracy for design purposes by the use of the formula shown in Fig. 2.

The average height of the ore depending on the opening for support is twice the width, although different materials develop different compressive strengths, and therefore would have different constants. The pressure supported on the belt is also independent of the height of the ore. Experience to date indicates that the constant 2 in the equation is sufficiently conservative for most purposes.

Ore Pressure on Belt

Many factors undoubtedly influence the ore pressure on the belt. Some of these include: (*a*) Specific gravity of the solids; (*b*) per cent voids in the material; (*c*) particle size and size distribution; (*d*) moisture content; (*e*) particle shape; (*f*) retention time within the bin; (*g*) temperature; (*h*) slope of the retaining hopper sides; (*i*) chemical activity of the material; (*j*) method of loading the bin.

Other factors may exist which have a subtle influence.

For some of the latest work investigating this field see the references given below.[1,2]

Sizing of Belt Feeder and Slot Opening

The sizing of a belt feeder and slot opening in the bin is dependent upon a number of design considerations, including: (*a*) Intended use of the feeder; (*b*) type of material; (*c*) particle size; (*d*) average moisture content; (*e*) bin size, shape, and capacity; (*f*) feed rate; (*g*) dimensions of space available for feeder installation.

Feeders which are intended to handle coarse material between the dumping pocket and primary crusher are designed quite differently than feeders intended for blending and feeding secondary ore to a grinding circuit or furnace charging.

Feeder-belt width is generally set so that the desired tonnage can be handled at a belt speed not to exceed 50 fpm. Hopper and belt width is also generally a function of the maximum particle size. A feeder should not be "throttled" in hopper width or gate opening to less than 3 maximum particle diameters, as at dimensions below this minimum, particles may bridge the opening and lock.

Belt Pull

Belt pull is made up of a number of different factors including: (*a*) The friction between the belt and the slide plate or idlers; (*b*) the friction between the ore and the belt; (*c*) the friction of the ore on the sides of the hopper and skirting; (*d*) the shear forces of the ore column at the gate-regulating depth; (*e*) the pulley and bearing friction of the feeder terminals.

Since each factor is difficult to evaluate separately and is often variable for one material, the practice to date has been to use a total coefficient of friction for the system. This coefficient is multiplied directly by the total calculated weight of the ore resting on the belt and results in the effective belt pull.

Slot-type belt feeders which are designed properly with the hopper width and gate setting not less than 3 maximum particle diameters, usually will have a total coefficient of friction between 0.3 and 0.6, depending upon whether the belt is carried on idlers or slide plate, the ratio of slot length to width, and gate opening. A conservative average coefficient for slide-plate feeders is 0.5.

Contributed by the Materials Handling Division and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9-13, 1957, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 57—SA-87.

[1] "Flow of Solids in Bulk Handling Systems," by A. W. Jenike, presented at AIME Minerals Beneficiation Division Meeting, San Francisco, Calif., September 24, 1954.

[2] Bulletin of the University of Utah No. 64, Utah Engineering Experiment Station, 1954, by A. W. Jenike.

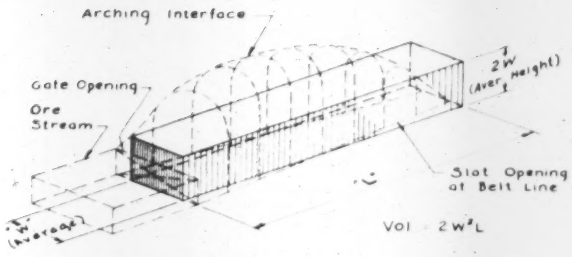


Fig. 2. Average ore height depending on the opening for support is twice the width

Reducing Belt Loading

Belt loading can be reduced, usually when slots are over 15 ft long, by placing a beam in the bin parallel to the feeder axis at a height above the opening, sufficient to support part of the ore volume. Passages around the beam should not be less than 3 diameters of the largest particle.

The addition of shelf angles within the bin hopper is another technique. This, in effect, narrows the slot opening, and protects the hopper sides by providing a shelf of ore which takes the wear. Shelf angles should be applied with caution and raised in the direction of belt travel. The lowest point of the angle (back end) should be at least $1^1/_2$ max particle diam above the belt.

Other Design Considerations

Belt Speed. Belt speeds can vary from almost 0 in. per min to as high as 50 fpm. In general, slide-plate construction is suitable for speeds of 0 to 25 fpm and idlers are most satisfactory for speeds from 25 to 50 fpm. Slot-type feeders are operating with belt speeds as low as 5 to 6 in. per min and up to 50 fpm.

Slide-plate-type feeders are particularly suitable for use with ores which are dusty, or so wet they tend to flow, since the slide plate supports the belt in a perfectly flat plane and makes skirting most effective.

Gate Openings. Gate openings on belt feeders are analogous to hydraulic orifices and can be expected to discharge from 0.6 to 0.8 the theoretical gate area depending on the characteristics of the material. This, of course, requires a correspondingly greater gate opening or belt speed to correct for design tonnage.

Power Requirements. Installed horsepower for this type of feeder is surprisingly low, often much lower than for other commercial feeders. Feeders are in operation which have slot openings up to 14 ft long feeding up to 20 tons per hr of 1-in. ore using a $1^1/_2$-hp motor. Other tonnages and slot sizes use correspondingly low power.

Hopper Design. Hopper design and skirting require careful consideration and a few precautions to insure a satisfactory final result. Long slot openings, of course, impose some special structural problems on the designer. The hopper must be rigid so that no bin-loading stresses are transmitted to the belt. The hopper also must be tapered so as to reduce side friction to a minimum and make skirting self-cleaning. Skirting must be designed carefully to prevent belt chafing and undue friction.

Skirting which can be adjusted or replaced without emptying the feeder, is very desirable. The clearance of skirt-supporting structure, shoulders, and so on, must be sufficient to prevent locking particles under these parts and chafing the belt.

Belt Life

Feeder belts need special consideration to insure a long trouble-free life. Slide-plate belts are generally specified with no rubber cover on the underside. Duck facing reduces the friction between the slide plate and belt to a minimum and will give a surprisingly long life.

Top covers on belts are generally heavy, with $^1/_4$ in. thick common for ore up to $2^1/_2$ in., and $^1/_2$ or $^5/_8$ in. thick for ore up to 12 in. Belts with breaker-strip and shock-pad top covers are particularly well adapted.

Belt plies are seldom under 5, and maximum is about 8 or 10. The number of belt plies is more often a function of rock size than belt tension. Slide-plate-type feeders should have a minimum of 1 ply and preferably 2 plies which can be worn away without destroying the belt strength. Belts should be endless vulcanized to prevent material from working through onto the slide plate or return belt. This imposes special consideration of the feeder design to allow the use of endless belts. Belt lacings can be used, but will wear out very rapidly compared to the belt. The new rayon-cotton belts are well adapted to feeder use since they are very flexible and can be applied successfully to feeders with an allowance as low as 3 in. of head-pulley diameter per ply in the belt. An allowance of 4 in. per ply is considered suitable for standard cotton belts.

Feeder-head pulleys are usually rubber lagged, preferably with the lagging vulcanized to the pulley and ribbed in a herringbone pattern, particularly for wet applications. Tail pulleys on feeders are usually the same diameter as the head pulley and preferably of the self-cleaning type.

Feeder Drives

Feeder drives are often gear motors coupled directly to the head shaft; however, low-speed feeders sometimes require bull gears and jack shafts. When exposed gears are used they should be generously proportioned and usually operated without lubrication. Slot length-to-width ratios generally vary from as low as $2^1/_2$:1 up to 15:1 with a few exceptions even higher. Slots up to 30 ft long have operated successfully under large bins.

Hopper gates of various designs are commonly used including double rack-and-pinion plate gates, segmented-arc gates, removable-bar gates, fixed and removable louvers.

Conclusions

Slot-type belt feeders are claimed to offer the designer faced with difficult materials-handling problems some very distinct advantages:

1 The slot-type belt feeder is a dependable feeding mechanism and will continue to feed materials which cannot be fed successfully by other means.

2 The slot-type feeder, properly designed, can blend ore within one bin to a remarkable degree.

3 The initial cost is usually 60 to 80 per cent of the cost of comparable feeders.

4 Maintenance is almost negligible with belt life from 5 to 15 yr or more. On one installation handling run-of-mine rock a belt feeder replaced an apron feeder with a resultant savings of approximately $1200 per yr.

5 Power consumption is usually less.

6 This type of feeder, because of its low power and dependable operation, lends itself to automatic control.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Editor*

Computer-Controlled Shipping Center

INTEGRATED data processing has been utilized for a new approach to inventory control, production scheduling, storage, and the processing of customers' orders at the Bucyrus (Ohio) Shipping Center of the Timken Roller Bearing Company. Designed and built within a year's time, the Shipping Center now handles 95 per cent of the Timken Company's bearing shipments centralizing operations previously scattered through several plants. Over 10 million pieces are handled and shipped each month by the packaging and handling equipment in the highly mechanized warehouse.

The new Shipping Center is a one-story 560-ft-long by 240-ft-wide building providing 140,000 sq ft of floor space. There are six receiving docks, 12 truck-loading docks, and two railroad-loading docks.

The building is rectangular with about $^2/_3$ of the floor space being used for the storage of bearings and bearing parts. The other third is utilized for packaging, packing, and shipping operations. Approximately 12 to 15 million cups and cones are kept in stock at all times, representing about a month's supply of bearings at the present rate of use.

The other important tool in this system is the IBM 650 Computer located in the Canton, Ohio, office. The major task of the computer is to keep track of inventory, scheduled production, and unshipped customer orders. This makes it possible to determine quickly whether or not a customer's shipping date request can be met.

In addition to the computer, other modern office machines linked together make a completely integrated system so that all related records can be made with a maximum use of machines and a minimum of manual effort.

Product is received and stored by a system of conveyers, lift trucks, and special equipment with a minimum of handling.

The IBM 650 Computer keeps track of inventory, scheduled production, and unshipped customer orders.

The information that goes into the computer is: (*a*) The previous day's balances of pieces on order, pieces in inventory, and pieces scheduled for production; (*b*) pieces placed in inventory on that day; (*c*) new orders received that day; (*d*) changes in existing orders; (*e*) orders to be shipped in the near future for which pieces have to be allocated; (*f*) changes in manufacturing schedules.

The answers from the machine as punched on IBM cards are: (*a*) Orders to be shipped in more than 14 days; (*b*) orders for which pieces have been allocated that day; (*c*) unallocated orders; (*d*) new balances of orders, manufacturing schedules, and inventories.

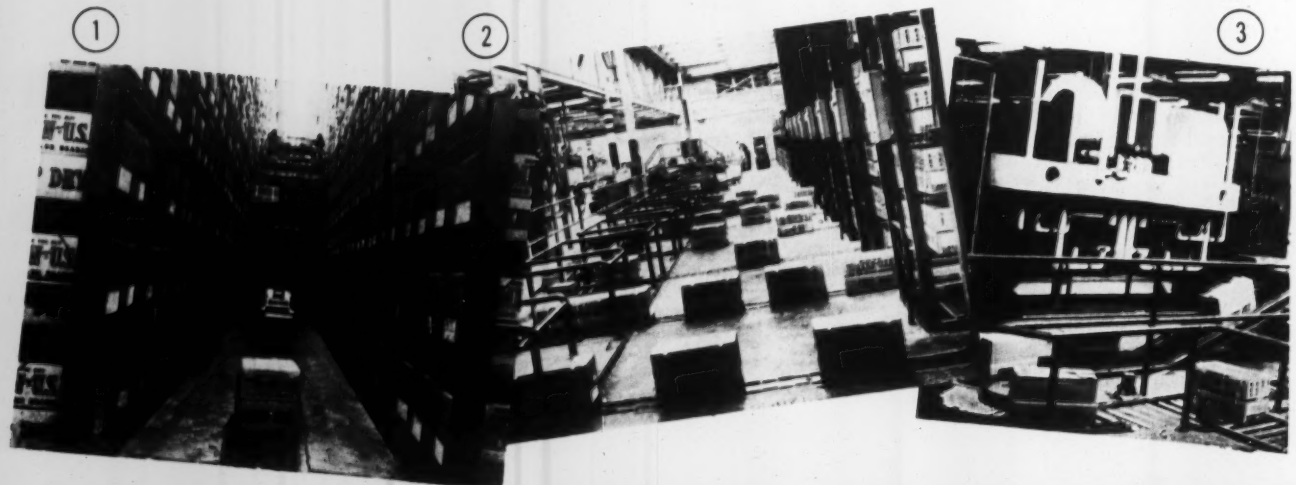
These answers ascertain the situation at the close of each day showing what will have to be shipped, and how many pieces are on hand or expected to be on hand so shipments can be made. The IBM 650 requires less than 2 sec to calculate all the answers for an item.

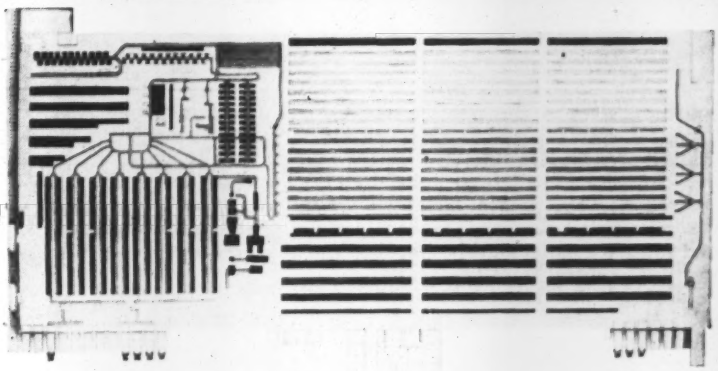
A Scheduler's Reference Report is prepared each day which shows pertinent data on every inventory item. The data include: Pieces on order for the current and next four months, the number of pieces in inventory, manufacturing schedules which may be past due, or are for the current month, and the next month.

Every item has two numbers to describe it. They are the Timken-bearing part number and the item number which translate the Timken-bearing part number into a "language" that can be used in the computer, by the Shipping Center, and throughout the entire system.

The Shipping Center operates on a three-shift basis. During the midnight shift product is pulled for the next day's shipment. Bearings are received, stored, packaged, packed, shipped, and billed during the other two shifts.

All bearings and parts are transported by truck and arrive at the Shipping Center on pallets. Timken Company trucks make regularly scheduled runs to the Center from the various production plants.





Shipping center plan permits material to flow from left to right. Horizontal lines indicate the storage area, right. The transfer station is in the center of the packing and shipping area on the left. Standard-packing lines are below the transfer station. Other specialized-packing lines are in the surrounding area.

The storage area is divided into three sections for pallet, box, and bin lots. Full pallets, consisting of the same part number, are stored in the pallet section. The box area receives full boxes, and the bin area is used for a storage of the less-than-full-box lots.

A lift truck unloads pallets from vans at the receiving docks. Full pallets, those of the same part number, are taken by the lift truck directly to the pallet storage section. Mixed pallets are placed on the conveyer by the lift truck and moved to the pallet unloader which mechanically unloads the boxes and stacks the empty pallets.

The unloaded boxes pass the IBM key punch operator. The operator controls the pallet unloader and conveyers that lead to the storage areas.

There is an IBM location card for every vacant space in the storage area. The IBM key punch operator punches the item number and quantity in each box on the IBM location card. This serves as the basis for moving items to the storage sections.

After the location cards have been inserted, the boxes move to one of three switches to be directed to a chain floor conveyer serving only the box storage area. The key punch operator can direct the flow of boxes from her station by means of electric buttons.

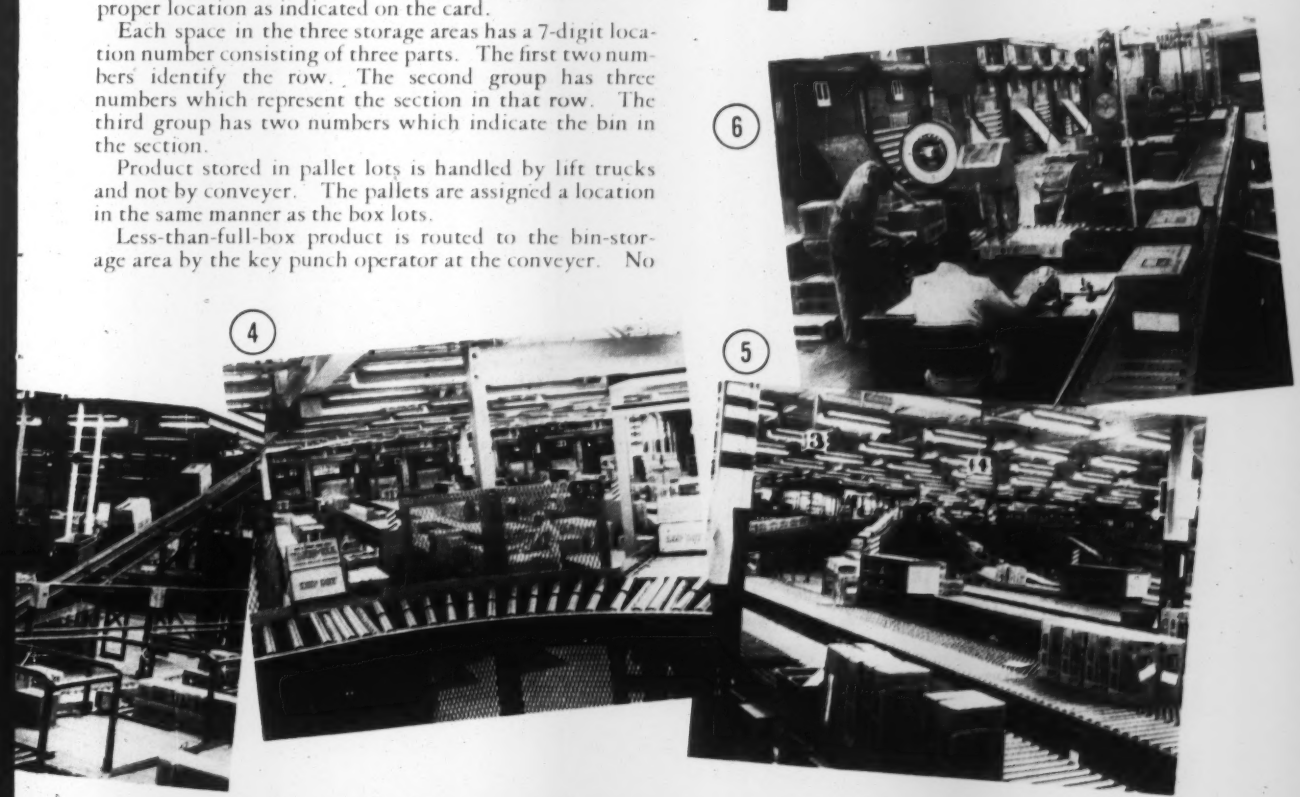
Once in the aisle, the boxes are lifted by the box-lift truck from the chain floor conveyer and placed in the proper location as indicated on the card.

Each space in the three storage areas has a 7-digit location number consisting of three parts. The first two numbers identify the row. The second group has three numbers which represent the section in that row. The third group has two numbers which indicate the bin in the section.

Product stored in pallet lots is handled by lift trucks and not by conveyer. The pallets are assigned a location in the same manner as the box lots.

Less-than-full-box product is routed to the bin-storage area by the key punch operator at the conveyer. No

A specially designed box-lift truck (1) lifts boxes from the floor conveyer to the proper bin. Chain floor conveyers (2) carry the product from the box-storage area directly to the transfer station. The conveyer makes a 180-deg turn (3) as it begins the ascent to the transfer station, 5 ft above the main floor level. Boxes and parts of boxes travel on conveyers leading from the transfer area to the proper order-packing line (4). Boxes travel to the packing benches shown in the foreground (5). Before a shipment is loaded on a truck, it is banded, demagnetized, and weighed (6). Portable conveyers can be placed inside the trailers, making the loading procedure quick and easy. Pallet loads can be transferred into van bodies by pallet-lift trucks.



conveyers run through the bin-storage area. The pieces are placed on small trailers to be pulled by electric scooters to the right location. Location, again, is assigned in the same way as for box lots.

Before the location cards are placed in the tub card file, duplicate cards are made and sent to Canton to serve in the IBM 650 Computer as inventory receipts and for other controlling records.

In assembling shipments the allocation cards are used to select the location cards for the pallets, boxes, and bin product needed to make the shipments. Marked on the location card, now called the "pick ticket," are the number of pieces, the packing line, and station where they will be sent, and the packaging code number.

Picking tickets are arranged according to location in the aisle, and placed in a holder at the head of the proper aisle. The operator can pick the product in one pass down each aisle.

Picking the product is essentially the reverse of the storage method. All box or bin lots travel by conveyer to the central transfer station to be distributed to different packaging or packing areas.

The transfer station is located in the center of the packaging and packing area about 5 ft above the floor level. Attendants read the picking tickets as the product arrives at the transfer station, and distribute product to special packaging, export line, service sales line, military packaging line, or directly to the packing benches.

Full pallets are pulled by a lift truck, and taken directly to the packing area. If special packaging is required, other than the standard packaging all bearings receive, the pallet must be unloaded and boxes routed through the central transfer station.

Box and bin lots that require special packaging, as ordered by the customer, are routed from the transfer station to that area. Bench loaders sort the product to one of the 35 packaging benches along with a supply of cartons and wrapping paper. All assemblage is made during the midnight shift. When the morning shift arrives, the benches are full of product ready to be packaged.

The Shipping Center system is flexible enough to handle rush or emergency orders. Since the Center operates most efficiently on set schedules, emergency orders can be filled during a set time each day.

The changeover to the new system was completed during a 2-week inventory shut-down less than 1 yr after initial plans were formulated. For a period of 1 week, 70 truck loads of bearings a day arrived at the Center. The huge transfer was completed in a relatively smooth manner.

Desk-Side Electronic Computer

A DESK-SIDE electronic computer about the size of a spinet piano, which can handle problems ranging from insurance premium computation to jet aircraft design, was introduced recently by International Business Machines Corporation. This computer, the IBM 610 Auto-Point, is mounted on wheels, and can be rolled from one location to another to perform some of the tasks previously fed to larger electronic calculators, including those in the $1 million or more class. The 610 will lease for $1150 a month, or may be purchased for $55,000. Outstanding features of the new computer are automatic positioning of the decimal point and simplicity of operation.

The 610 Auto-Point Computer, it was pointed out, will probably find its most widespread use in engineering laboratories. For example, at a press demonstration, the 610 tackled computations involved in the trail design of a power transformer. Previously, an engineer working with a desk calculator required six hours to solve the problem. The 610 had the answer in less than 20 min. In solving other problems, the machine has demonstrated that it can do the work of up to 60 desk calculators. The computer is capable of 214 additions or subtractions, and 52 divisions or multiplications a minute.

The 610 is a high-speed, general-purpose machine embodying many features—including a magnetic drum "memory"—normally found only in giant electronic data-processing systems. The 610 is completely self-contained, from initial "programming" (feeding the computer its working data and operating instructions) to final output on punched tape or an IBM high-speed electric typewriter. The computer requires no air-conditioning.

Other outstanding features of the new computer are ease of programming and a flexibility which makes it applicable in a wide range of problem areas. Some of the jobs the 610 can handle are: Bridge and highway design; stress, flutter, and vibration analyses encountered in jet aircraft design; sales forecasting; matrix arithmetic involved in communications circuit design problems; actuarial computations; reduction of test data for guided missile performance studies; cam design and performance analysis for industrial equipment manufacturers; and heat-transfer calculations for the petrochemical industry.

Of note is the 610's ability to accept sentence-type instructions composed of any number of individual commands, causing the machine to execute entire functional operations such as the computation of the square root of a sum, and the printing and punching of the answer.

Once the 610 has been given a program, or set of

Operator checks arithmetic unit of IBM's new 610 Auto-Point Computer, a powerful desk-side machine that can solve many of the problems now being handled by large-scale electronic computers. An outstanding feature of the machine is automatic positioning of the decimal point. Results of computation are printed out by an IBM electric typewriter, *center*.

instructions, for the solution of a certain type of problem, the program may be used over and over again. All the operator has to do is insert data into the machine, which will process it automatically.

The Auto-Point Computer takes its name from its ability to provide automatic decimal point control. To do this, the operator has only to throw a toggle switch to assure that the decimal point is positioned correctly throughout all computations and in final results.

Boron Fuels

ACCELERATED rates of consumption, and the premium placed on weight by transonic aircraft and missiles have stepped up the search for more efficient fuels, with implications for many types of combustion engines.

Articles by R. A. Carpenter of Midwest Research Institute in *Industrial and Engineering Chemistry*, and by Hugh Harvey of the Shell Oil Company in the *SAE Journal*, have outlined some of the requirements.

Oxidation in the broader sense of the term is the basis of most combustion reactions. Nitric acid, hydrogen peroxide, and ozone are favorite substitutes for oxygen, and there is at least one high-performance aircraft flying today that uses nitric acid and kerosene as the fuel combination.

Fuel-oxidizer combinations are usually rated in terms of specific impulse, which equals the pounds of thrust available per pound of fuel consumed per second. Other desirable properties are high heat of combustion, and low atomic weight. The maximum flame temperature is limited by the ability of the construction materials to withstand the temperature. Also, the specific heat of the products should be low, which means that simple molecular structures should be present in the exhaust products. The elements of lowest atomic weight in the fuel-oxidant system make the most efficient exhaust gas because a given mass of low-molecular-weight gas will contain more molecules than one of a higher molecular weight; consequently, use of a low-molecular-weight gas will result in a greater expansion in the nozzle of the engine, and therefore a higher velocity in the exhaust gas.

Compounds of hydrogen, lithium, sodium, beryllium, magnesium, aluminum, silicon, and boron all have a higher heat of combustion than gasoline. Of these, only compounds of hydrogen and boron meet the tests of desirable characteristics, properties, and availability.

Lithium is almost as abundant as zinc, but its ores are dilute, and there are few good ore deposits. Beryllium compounds are ruled out by the difficult metallurgy of the ores, demands for nuclear energy uses, and toxicity.

Of all the possibilities, the boron hydrides seem to have the most promise. Boron ores are concentrated, and recovery is easy and inexpensive. Diborane, B_2H_6, is a gas; however, it polymerizes into higher hydrides such as B_5H_9, a liquid, and $B_{10}H_{14}$, a solid. Alkyl boranes increase the number of molecular types for consideration.

Synthetic chemistry will undoubtedly play a major role in the development of boron fuels by providing a large number of new compounds of the appropriate elements on which to base structure-property correlations. From these should emerge a fuel with most of the desirable handling properties, plus an inherent high heat of combustion.

Industrial-Engine Analyzer

A HAND-PORTABLE, multipurpose industrial-engine analyzer made by the Sperry Gyroscope Company displays pictorially the information formerly obtained from as many as three electronic instruments to give a complete, cost-cutting look at the inner mechanical functioning of complex industrial engines, while in operation. It enables operators and maintenance men to monitor reciprocating engines—whether spark-ignited or diesel—to keep them operating at continuous peak efficiency. It also detects and pinpoints malfunctions as they develop within engines.

Sperry's lightweight analyzer accurately monitors engine operation, providing three types of data: Ignition, vibration, and pressure.

Nine natural gas transmission companies and one chemical company already have ordered the equipment. Widespread use is expected throughout the natural gas, chemical, petrochemical, and other industries where large reciprocating engines are used.

Early tests of a prototype analyzer, which used only two (ignition and vibration) of the three types of data supplied by the advanced production equipment, proved its ability to save approximately $4800 a month for an industrial plant using 80 natural gas engines.

The analyzer, employing a highly specialized oscilloscope, probes the inner recesses of engines, and presents functional information in picture form on a 5-in. cathode-ray screen.

Simplicity of operation and easy interpretation of visual electronic patterns portrayed on the screen readily make it a line operator's "tool," as well as an engineering aid. A qualified operator can use the industrial-engine analyzer competently after a few hours of instruction.

A 36-lb portable industrial-engine analyzer uses ignition, vibration, and pressure data, picked up by five quickly made connections, to give a complete picture of the operation of any reciprocating engine without shutdown

Simulating the "Thermal Barrier"

At supersonic speeds, air vehicles must withstand temperatures above 2500 F. To investigate and overcome structural limitations, the Westinghouse Electric Corporation has developed a complete elevated-temperature test facility. The facility can create 2500 F temperature in 12 sec to enable aircraft builders and designers to pretest structural parts and whole aircraft in simulated flights through the thermal barrier where metals distort, melt, or vaporize completely.

Heating of the aircraft surface through friction and compression of the air is related to the difference between the effective air temperature and the skin temperature of the vehicle. Under transient flight conditions, the temperature of the aircraft varies with time. Because heat flow is variable, the temperature distribution throughout the aircraft is uneven. This condition results in differential thermal stresses arising in the structure which are superimposed upon aerodynamic structural loads. An elevated-temperature test facility simulates all of these load effects in conjunction with the differential thermal stresses. The Westinghouse equipment is used to arrive at solutions of thermal-transient distribution throughout different types of aircraft structures.

Banks of quartz infrared lamps are used as the heating source. Each lamp is rated at 1000 watts, 240 volts, and is operated, in many cases, at 440 to 480 volts. These lamps operate satisfactorily at 600 volts and up to 900 volts, if necessary. In addition to the 10-in., 1000-watt, 240-volt nominal rating lamp, 2500-watt, 480-volt and 5000-watt, 950-volt lamps are available. These lamps have an extremely rapid warm-up time.

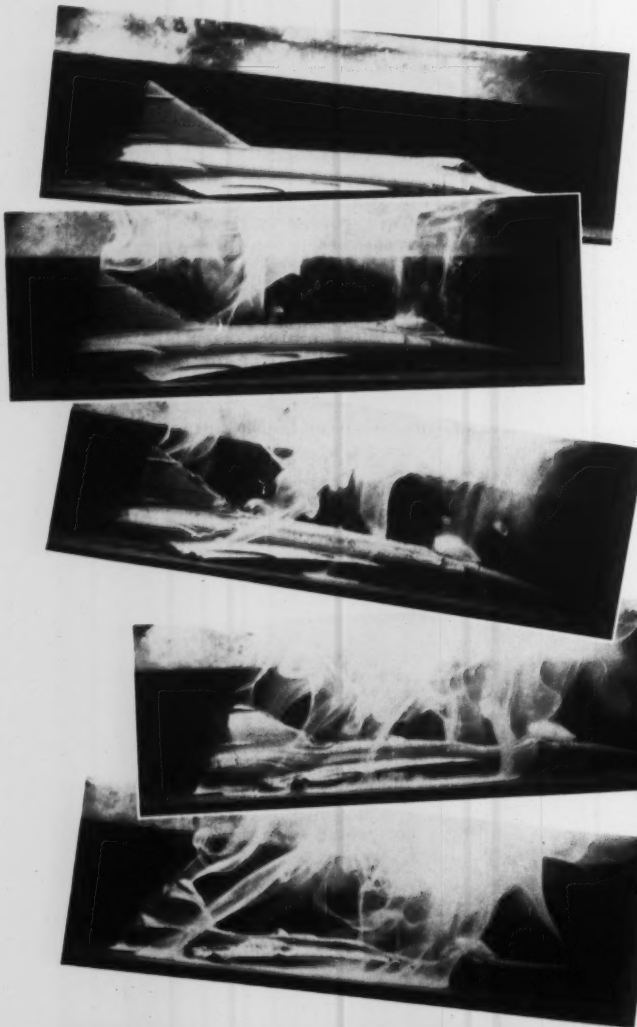
Induction-heating equipment can also be used as the heating source. Actually, surface heating with power inputs of 150 to 705 kw per sq ft is possible with radio-frequency induction-heating equipment.

The effective heating voltage impressed across a fast-response, variable-resistance load is controlled by the ignitron unit which provides a rapid response and a broad range of power control for the large number of infrared lamps.

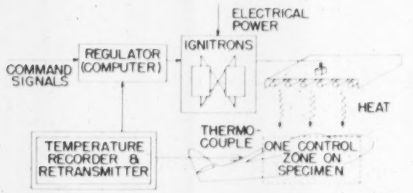
This equipment has an extremely high short-time overload capacity. Current ratings of 3000, 1600, and 1200 amp at 3, 15, and 25 sec, respectively, are achieved. Each short-time rating can be followed by a continuous rating of 300 amp.

The response of the power control is rapid. For a change in control voltage the effective output voltage squared (heating effect into a constant resistance load) attains 63 per cent of its final value in 0.02 sec.

A high-speed temperature recorder transcribes the temperatures of the control zones of the aircraft or missile under test. At present, the temperature recorder is calibrated for thermocouples in a temperature range from -350 F to +2650 F. Chromel-alumel thermocouples used with this equipment are provided in three ranges; −350 to 650 F, zero to 1000 F, and −350 to 2650 F. The temperature-sensing and recording equipment incorpo-

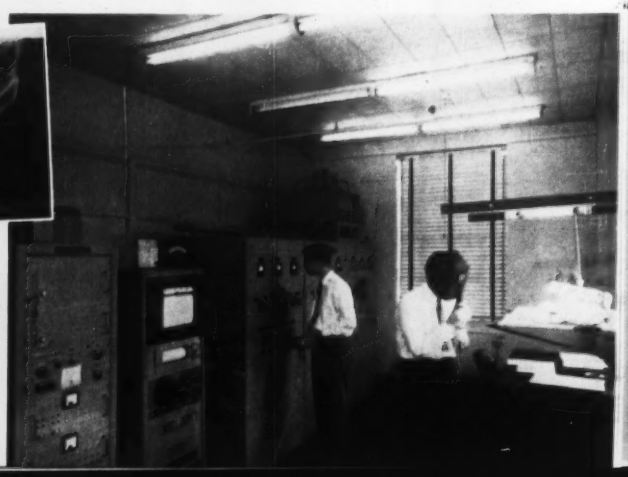


◀ The model shown in the first photograph was used to demonstrate the rapid rate of temperature increase that is possible on structures placed under the infrared lamps. Actually, in normal use, the facility is used to test full-scale air frames and components. The test facility is capable of reaching temperatures of 2500 F or higher. The other photos were taken at 1-sec intervals beginning at 2 sec and ending at 6 sec.



Elevated-temperature structures test facility system

Elevated temperature test facility installation located at Westinghouse Electric Corporation's East Pittsburgh plant. This system can operate up to 2500 F. This equipment includes ignitron power controller, lamps and reflectors, temperature-sensing equipment, and a precision regulator to regulate time versus temperature or aerodynamic heating. ▼



rate special features developed by Westinghouse and the Bristol Company to eliminate the high stray fields induced by the rapid power changes, and unusual power-wave form from the ignitron units.

Future tests will require surface temperatures of 5000 F and above. Exclusive of the temperature recorder, the elevated-temperature test facility operates reliably in the higher temperature range.

The regulator develops the control signal used to modulate the ignitron controller.

In one method, the command signal, showing the power into the aircraft required to simulate a given flight trajectory, is developed by the computer. Using an injected coefficient of heat transfer, and the effective temperature of compressed air, and the measured value of the skin temperature of the vehicle, the computer instantaneously calculates a regulating signal. This calculated signal is the power which it is desired to inject into the aircraft to simulate the flight condition which would occur.

This regulator has exclusive compensating network refinements of operating features specifically developed for this application by Westinghouse; Berkeley Division of Beckman Instrument, Inc.; and Alabama Automation Corporation.

The ventilated bus-duct system consists of low-voltage-drop plug-in bus way using aluminum bus bars. The receptacles for plug-in devices are equipped with barriers to prevent live parts from being accessible at any time during installation or removal. Circuit-breaker plug-ins prevent removal from the receptacle until the breaker is in the off position.

A thermal overload relay co-ordinated with the long thermal characteristics of the contactor and bus work, and an induction-disk overload relay co-ordinated with the short-time characteristics of the ignitron tubes, permit full use of the equipment capacity.

Other safety features include extensive interlocking.

Skid-Warning "Foot Thumper"

A SKID-WARNING system, introduced by the Aviation Products Division of The Goodyear Tire & Rubber Company, senses an impending aircraft skid before it occurs and warns the pilot to take corrective action by rapidly thumping the bottom of his foot with a vibrating plunger.

The foot thumper, which projects through a hole in the brake pedal, is triggered only when a sensory device in the wheel axle detects abnormal wheel slow-down, such as wheel lockup, during a braked stop. The plunger continues its staccato tapping until the pilot eases brake pressure sufficiently to allow the wheel to rotate again.

The new warning device differs from the automatic Antiskid system the company has had on the market since 1953, in the method of handling the excessive brake pressure causing a tire to skid. Skid-warning notifies the pilot to be ready to take corrective action, while Antiskid automatically controls brake pressure on a skidding tire through the action of a hydraulically actuated solenoid valve. When the skid has stopped the valve automatically allows braking to begin again.

Arc-Image Furnace

TEMPERATURES approaching that of the sun's surface have been produced with ordinary motion-picture-projection mirrors. Rays from a carbon arc are concentrated into a small but extremely high-energy beam that can produce temperatures above 7000 F at the research laboratories of National Carbon Company, a Division of Union Carbide Corporation.

Previous arc-image furnaces have used specially designed parabolic mirrors to focus the arc's energy onto the substance to be heated.

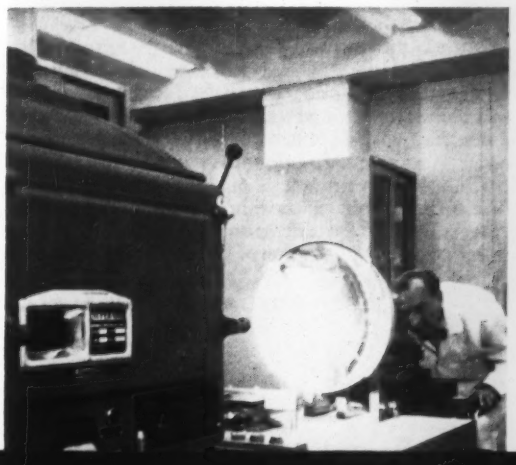
The new design uses two elliptical mirrors of the standard type found in motion-picture projection equipment. One mirror directs the energy of the arc at the other, which in turn concentrates the radiation on the specimen being heated, forming a life-size image of the actual arc.

The equipment is highly compact and portable and can be operated practically anywhere, at any time. It is said to produce results comparable to that of a solar furnace with a 60-in-diam reflector, but is independent of the sun's rays for its energy, and can be operated under any climatic conditions.

Arc carbons less than $\frac{1}{2}$ in. in diam are focused by mirrors approximately 18 in. in diam and placed about 6 ft apart. The arc draws a current of 200 amp which is approximately twice the electrical equipment of a modern home. Normal operating voltage is 80 volts. Extension to larger arcs, with higher power to heat larger samples, is already under way.

A shutter can be placed in the narrow beam midway between the two mirrors to turn the energy on and off very quickly without disturbing the arc. A tilted mirror can be placed at the same point to tip the beam at any desired angle if it is to be used for the melting of a specimen.

Possessing the same contamination-free qualities as the solar furnace, it is a very valuable research tool particularly for metallurgical work and might well become a useful production tool in the future as high-temperature operations become more common in industry.



Left, **temperatures almost as hot as the sun's surface have been produced with standard motion-picture projection equipment.**

Right, **a piece of high-temperature fire brick begins to melt and the molten material literally flows from the crater**

The first practical fuel cell, which consists at present of nine hollow, porous carbon electrodes grouped in a round plastic housing. A carbon header on each end channels the hydrogen and oxygen gases into the proper electrodes, and electrical connections conduct away the power.

Electricity From Gases

THE direct conversion of the chemical energy of gases into electricity has been accomplished with a fuel cell capable of economically producing thousands of watts of power. Using hydrogen and oxygen as fuel, the new source of power has been developed at the Research Laboratories of National Carbon Company, a Division of Union Carbide Corporation. Designed to work at ambient temperature, and at approximately atmospheric pressure, the new fuel cell is the first that does not depend on high temperatures or pressures for efficient operation. Normal operating temperature ranges from 120 to 140 F.

Unlike conventional batteries, fuel cells remain essentially unchanged during their operating life and produce electrical energy from chemical fuel supplies as needed.

The new fuel cell is merely a sealed jar into which hydrogen and oxygen are fed through special chemically treated hollow porous-carbon electrodes. The electro-

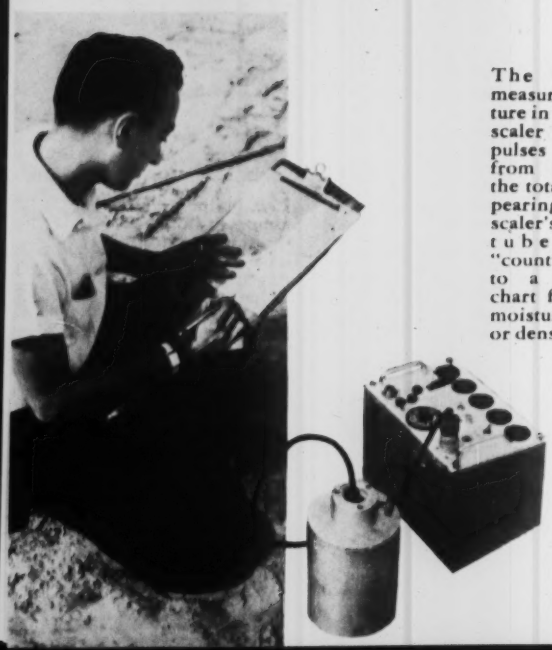
The small white wafer indicated by the pencil is a super-strong adhesive. Brass, polyethylene plastic, and rubber can be successfully joined. In the model shown here, the top layer is brass. It is joined to polyethylene, which is bonded to rubber, which is then joined to the bottom layer of brass. The entire "sandwich" is held in a huge machine for testing the bond strength.

Bonding Plastic to Rubber and Metals

EXCELLENT bonds can be made between polyethylene and brass or brass-plated metals; and between polyethylene and neoprene, natural rubber, or GR-S synthetic rubber by a new process perfected at Bell Telephone Laboratories. Based on a synthetic material known as "partly hydrogenated polybutadiene," the adhesive is so strong that it will resist a pull of approximately 1000 psi, much greater than present-day pressure-sensitive adhesives.

The partly hydrogenated polybutadiene, known commercially as Hydropol, is manufactured by the Phillips Petroleum Company of Bartlesville, Okla. Any degree of unsaturation of the polybutadiene between 3 and 30 per cent gives the best bonds. Various materials are added to the Hydropol to make it capable of vulcanization.

Apparently, the hydrogenated polybutadiene adheres to the polyethylene because of its similar chemical structure and thermoplastic properties. The bond to a vulcanizable rubber is probably due to the formation of sulfur cross links at the interface, that occur during the vulcanizing process.



The d/M-Gage measures the moisture in the soil. A scaler counts impulses received from the probe, the total count appearing on the scaler's five glow-tubes. This "count" is applied to a calibration chart for a direct moisture content or density reading.

Moisture-Content Gage

THE "d/M-Gage" is a new, completely portable field instrument made by Nuclear-Chicago Corporation for rapidly and easily measuring moisture content or density in a wide range of organic and inorganic materials.

A single operator using the d/M-Gage can obtain accurate moisture of density determinations in 2 min—less than one tenth the time required by other systems—at the site of application.

Operation principle of the d/M-Gage is based on the varying degree that radioactivity is "scattered" when placed in contact with masses of different moisture content or density. Measurement of this scatter provides a precise measurement of moisture content or density. Application of this principle is made through the use of either a moisture probe containing a radioactive radium-beryllium source of fast neutrons, or a density probe containing a cesium-137 gamma-ray source. The probes

chemical reaction of the gases at these electrodes produces an electric current, with only water as a by-product. With the water disposed of by evaporation, the life of the fuel cell is theoretically unlimited. Cells have been operating 8 hr a day, 5 days a week for the past year, with no signs of deterioration, a type of operation that is harder on the cell than continuous, around-the-clock operation.

Operation at approximately atmospheric pressure has the obvious advantage of eliminating heavy, costly pressure vessels. If increased output is desired, however, it can be obtained by increasing the pressure. For a given cell, higher outputs vary directly with pressure.

The efficiency of operation of the new fuel cell depends on how it is used, but the general efficiency range is from 65 to 80 per cent when operated at normal temperatures and pressures. Research and development to date indicate that the optimum fuel cell design will be one which will produce approximately 1 kw of power from a package unit 1 cu ft in volume.

The voltage across the electrodes of the new fuel cell is approximately 1 volt. By varying the number and size of cells, many combinations of voltages and currents can be obtained. Basically, the fuel cell is most desirable for high-current, low-voltage use.

Although pure oxygen is required for higher current densities, the new cell can be operated with hydrogen and air for producing smaller amounts of power. The cell can also operate with hydrogen containing considerable impurities, which means that standard industrial grades of commercial purity can be used.

The inherent advantages of the fuel cell make it an ideal source of silent electrical power in remote locations where conventional fuels or water power are not available. Military communications systems, mobile power units, and stand-by power plants are a few.

As a producer of electrical energy, the fuel cell depends on a practical and economical source of hydrogen, a gas that at present is quite expensive and requires relatively bulky pressure vessels.

A layer of bonding agent 2 to 3 mils thick is desirable for proper adhesion. The agent may be made up in a solution and sprayed, brushed, or dipped to provide the desired layer, or a thin sheet can be fabricated and inserted between the materials to be bonded. The bonding is accomplished with heat ranging from 250 to 350 F and pressures of 100 psi or less, although higher temperatures and pressures may be used. The process may be extended to plastics related to polyethylene, Bell Laboratories reported.

Peel strengths up to 100 lb per in. and tensile strengths of 1000 psi can be readily achieved. These values are considerably higher than those possible with previously available techniques.

More than 550 million lb of polyethylene were produced last year. Industry experts estimate that it will become the first billion-lb-a-yr plastic, and that this level of production may be achieved by 1960. The bonding agent should greatly increase the applications of polyethylene products.

The process will be particularly useful in protecting metals from corrosion since the polyethylene can be fixed directly upon the metal without the use of intermediate material other than the adhesive.

are used interchangeably with a radioactivity counting instrument (scaler).

Measurements are obtained by inserting the desired probe into the material being tested and reading the scaler for a visual-scatter "count" which varies with moisture or density variations. This count is located on a calibration chart and the moisture content or density of the material is read directly from the chart itself.

An outstanding feature of the system is the substantial volume of material analyzed in a single operation. The probes normally measure a spherical volume of material with an average diameter of 14 in. Moisture or density measurements can be made at any depth within a material, ranging from the top 12 in. to 60 ft below the surface.

Accuracy of the system is within 2 lb per cu ft for density determinations over the range from 50 to 150 lb per cu ft. Moisture determinations are accurate to within $^3/_4$ lb per cu ft over the range from 0 to 100 per cent moisture content.

Coal-Fired Plants for Ontario Hydro

Faced with the exhaustion of major sources of hydraulic power in Southern Ontario, the Hydro-Electric Power Commission of Ontario is negotiating for two new major coal-fired thermal generating stations at Long Branch and Burlington. In addition, the Commission's plant on the Toronto waterfront will be brought to its full capacity of 1,200,000 kw in 1960 with the addition of four 200,000-kw units now in progress.

The $250-million Long Branch plant is expected to be of 1,800,000-kw capacity, larger than any other similar plants in existence in the world today, and the Burlington plant will be of similar proportions.

Although the technical details for the Long Branch plant are still in the planning stage, the specifications for the steam generators and their auxiliary equipment and the turbogenerator have been issued for the submission of bids.

The steam generator is to be suitable for using pulverized coal as fuel and will supply steam to one condensing-type steam turbine generator, the boiler and turbine constituting a complete unit. Specifications:

Actual maximum continuous steam flow for boiler	1,900,000 lb per hr
Minimum stable steam flow, at 15 per cent load	285,000 lb per hr
Expected maximum continuous reheater steam flow per boiler	1,700,000 lb per hr
At the outlet of the secondary superheater steam pressure will be	2450 psig
Final total steam temp will be	1050 F
Reheater conditions:	
Expected inlet steam pressure	475 psig
Reheater pressure drop	
in reheater proper, per cent of reheater inlet steam pressure	$7^1/_2$
in connecting piping, per cent of reheater inlet steam pressure	$2^1/_2$
Total, 10 per cent	
Expected inlet steam temp	660 F
Final outlet steam temp	1000 F
Steam temp control range at operating pressure	
leaving secondary superheater	950,000 to 1,900,000 lb per hr
leaving reheater	850,000 to 1,700,000 lb per hr
Feedwater temp at inlet of economizer	460 F
Expected maximum continuous blow-down	1 per cent
Expected maximum make-up	3 per cent
Excess air at economizer gas outlet	16 per cent
Air temperature entering regenerative air heaters	80 F
Gas temperature leaving regenerative air heaters, uncorrected for air leakage	270 F

The turbogenerators will be rated 300 mw, 353 mva, 85 per cent pf, 60 cycles, 13,800 volts. It is proposed to design the station for six 300-mw units ultimately, although even this may be changed if the rating of future units is increased.

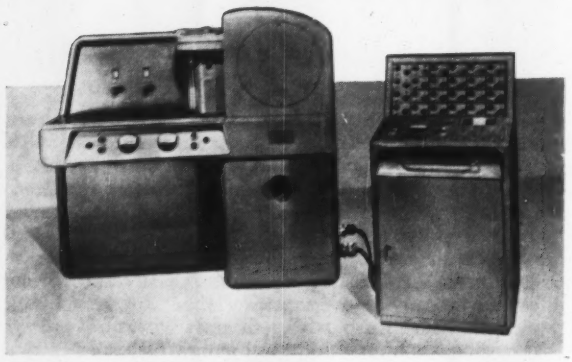
Dockage facilities at the lakefront plant will be capable of handling between 4 and 5 million tons of coal per yr, or the equivalent of 70,000 carloads.

The decision to build thermal-electric plants fired by coal imported from the United States, rather than nuclear plants using uranium mined in Ontario, was carefully weighed. The Commission has stated that, "If it were possible to build a British-type gas-cooled graphite-moderated reactor plant in Canada in 1961 (when demand will have to be met), the energy derived from it would be at least twice the cost of that obtainable from a base-load coal-fired plant. Improved versions of such plants would not appear to be economically competitive in Canada before 1977."

This does not mean that Canada is neglecting the development of nuclear power. The heavy-water type of plant which is the basis of the program of Atomic Energy of Canada Limited at Chalk River, appears to offer the best prospect and "there is sound reason to hope that a plant of this type may become practicable and economical for base-load application before 1970."

Push-Button Analysis

PRECISE qualitative and quantitative analysis by nondestructive methods, in one fiftieth of the time required for chemical methods, is offered by Norelco Autrometer, manufactured by Philips Electronics, Inc., Mount Vernon, N. Y.



The Norelco Autrometer consists of two units, a 56 × 54 × 35¼ in. main-chassis assembly weighing 2400 lb, and a smaller programming console weighing 400 lb. It operates at 220 volts, 60 cycles, single phase, drawing 25 amp. Cooling water must be supplied.

The machine, whose range has recently been extended to cover all elements from magnesium element 12, to californium element 98, utilizes fluorescent x-ray spectrography to compare a standard specimen with a sample representing a raw material or finished product. Sample may be in solid, liquid, or powdered form.

Any 24 elements may be selected for analysis from the total range, with stops preset at the factory on the sequential goniometer portion of the apparatus. These will cause it to pause at each selected preset channel position for an intensity count. Arrangement is made for readily cutting out any channel for which no analysis is desired. Channels may be restored with equal ease.

Each of these elements is represented at the programming console by a small rectangular panel with dial adjustments for milliamperage setting and counting

Self-Discharging Collier

FIRST East Coast ship to be designed as a self discharger and largest of its kind has been ordered by Pocahontas Steamship Company for delivery in October, 1958. The new super collier will unload coal at the rate of one ton per sec, 3600 tons per hr, and will carry 24,000 tons. Conventional colliers carry 11,500 tons and take almost 50 hr to discharge at 300 tons per hr. The discharge system is dust-free and will allow high-speed unloading without air pollution. The stern section of a 16,500-ton T-2 tanker will be used in the construction.

The only shoreside equipment required will be a simple hopper and take-away system. The Salem Harbor Station of New England Electric Company is building an underground belt conveyer system under the open coal-storage area that will allow complete automation in coal-discharging operations. The belt is enclosed in a 10-ft-diam pipe, equipped with overhead gates that permit coal to flow by gravity from the open-storage area.

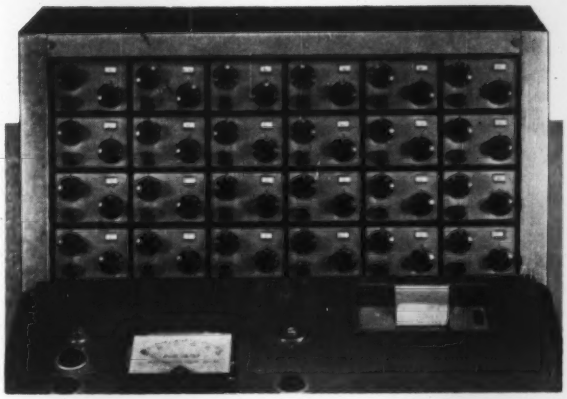
Standard operating procedure is for the ship to come alongside and discharge cargo by her self-unloading boom conveyer. Pivoted at the spar deck, the boom can swing through a horizontal arc of 100 deg on either side of the ship, and can be raised to permit piling coal 60 ft high. The boom can be aimed into a shoreside hopper, or swept in a series of arcs to stockpile coal on a ground-storage area. The super collier can also discharge into a barge moored alongside.

Push-button operations allow complete and instantaneous control over all self-unloading mechanism. The ship is 635 ft long and has a loaded draft of 30 ft.

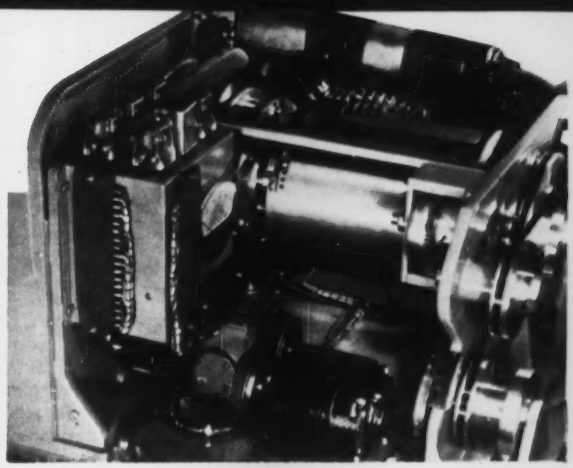
The use of self-discharging super colliers will give all Atlantic deep-water terminals easy access to the three great producing Eastern coal fields at the lowest mine-to-storage transportation cost.

A new onshore take-away system to be used with the super collier is under construction at the Salem Harbor Station of New England Power Company. An underground belt conveyer running from ground storage area and feeding into the plant is enclosed in a 10-ft-diam pipe.

Pocahontas self-discharging super collier is designed to deliver 1,440,000 tons per year with 1-ton-per-sec dustless discharge. The ship eliminates need for conventional discharging facilities. All equipment now required onshore is replaced by automatic equipment built into the ship itself.



The programming console contains 24 small control panels, one for each of the 24 elements, preset at the factory. The start button initiates the entire operation. The print-out shows a reading for the element at position 17 with a ratio of 1.550 as compared to the test specimen.



Heart of the control mechanism is a sequential goniometer. Upon initiation of a run, the goniometer is automatically driven from zero to higher 2 θ positions, pausing at each preset channel position. Any channel may be omitted by use of a "skip" control on the panel.

factor. The counting-factor dial is marked 5.0, 1.6, and 0.5 representing the percentage of statistical accuracy obtained from 4000; 40,000; and 400,000 counts. The length of count desired can be selected so that shorter counts may be used where statistical accuracy is not as significant.

Once the machine has been programmed and standard and test specimens have been inserted, a single push button starts the operation. The specimens are irradiated with x-rays and scanned element by element, and the amount of radiation reflected at the characteristic angle of reflection for that element is measured by a scintillation or proportional counter. The ratio of the amount of that element present in the standard and test specimen is computed and presented on the print-out tape with an identifying number representing the element in question. One to 3 min are required for each element, and the Autrometer progresses automatically from each element to the next which has been scheduled. At the conclusion of the reading for the 24th element, the machine resets itself and is ready to examine another specimen.

The new Autrometer provides an accurate and rapid means of analysis of products in any critical stage of manufacture, and indicates the need for addition, omission, or removal of elements to guarantee uniformity of mixes or batches, or to attain a desired degree of purity of components. The Autrometer is a tool for maintaining precise quality of incoming raw materials, processed and finished products. It is particularly useful in the field of alloys, lubricants, rubber and plastics, with many potential uses in other areas.

Plastic Jigs and Fixtures

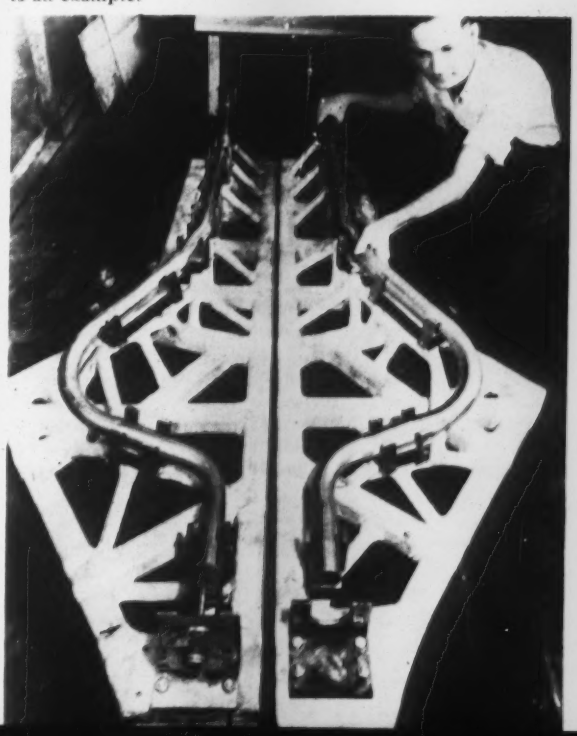
GLASS-REINFORCED epoxy-forming dies are in use in production operations, and glass-reinforced epoxy jigs and fixtures are used for quality control in several types of industries.

Use of tooling compounds based on Bakelite epoxy resins and supplied by Mainland Plastic Industries, Inc., Hazel Park, Mich., has provided drastic reductions in both costs and time. Close tolerances can be held in fabrication, and dimensional stability is maintained throughout the life of the tool. These epoxy resins cure at room temperature, hold tightly to inserts, bond directly to backing structures, and adhere strongly to reinforcing materials.

Lightweight tools made with Bakelite epoxy resins are easier to handle than conventional tools, which means less worker fatigue. They are less expensive to build because of the elimination of costly machining and the simplification of many fabricating operations.

Epoxy tooling compounds can be cast or laid, up to the final shape, in one operation. Since many conventional finishing and dovetailing steps are eliminated, tooling time and cost has been reduced 50 to 70 per cent on some items. On some production changeovers, new tools have been produced over a weekend which would ordinarily require several weeks' delivery time.

Tools, dies, and checking fixtures made with tooling compounds based on Bakelite epoxy resins are used by Arvin Industries, Inc., Columbus, Ind., to shorten production time and reduce overhead. The automobile tail pipe checking fixture is an example.



Nuclear District Heating

SWEDEN, which has no oil and only sufficient water power for another 15 to 20 years' expansion, has very large deposits of uranium in low concentrations in oil-bearing shales.

According to an article on "Swedish Nuclear Reactors for District Heating," by P. H. Margen of the Aktiebolaget, Atomenergi, Stockholm, in *The Industrial Heating Engineer* of London, for September, 1957, the first stage in the Swedish atomic energy program provides for the construction of two reactors which will be used for district heating, and will thus reduce the import of oil fuel for domestic heating.

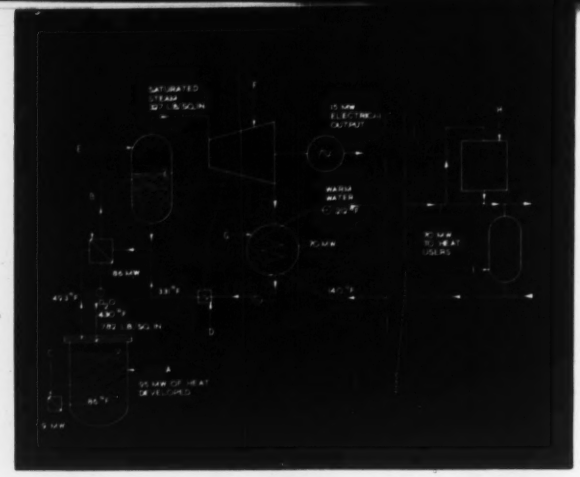
Sweden already has about eight district-heating schemes based on oil fuel, most of which are planned to reach heat outputs of the order of 50 to 150 mw of heat within a few years.

Of the first two industrial nuclear projects, one is designed for combined heat and electricity generation with a back-pressure turbine installation, and the other is designed for district heating alone.

The sintered-UO_2-fueled combination heat and electricity reactor will supply Farsta, a suburb of Stockholm, with heat. The total heat demand for the network connected to the reactor is expected to reach a maximum of 140 mw in 1961, one year after the reactor is scheduled to start operation.

Since part of the heat demand has a very low load factor, peak load and reserve-duty demand will be supplied by oil-fired boilers, leaving the reactor to take 70 mw of base heat load with an average annual load factor of about 50 per cent in the first years. The load factor will improve as the system grows.

The reactor coolant is heavy water under a pressure of about 900 psi, converted to saturated steam at 340 psi through a bank of four heat exchangers. The back-pressure turbine will produce 14.5 mw of electricity in winter, and 16 mw in summer; and the heat of condensation of about 70 mw will be available for district heating. An oil-fired superheater may be added to the installation to increase electrical output by about 10 mw. Moderator and coolant are contained in separate circuits to allow low-temperature operation on the moderator, and reduction in the critical size of the reactor.



Circuit diagram for the combination electric-generating and district-heat-supplying reactor

The other station, designed for heat alone, will supply about 75 mw of heat for the town of Västerås which already has a district-heating system supplied from a large oil-fired electric-generating station. The reactor will be as simple as it is possible to make a nuclear heat station. Coolant channels and fuel cans will be of aluminum. The moderator will also serve as coolant since coolant temperatures are low in a station producing only heat.

Both plants are expected to be approximately competitive with oil-fired district-heating schemes.

Technical Briefs

(Brief technical notes on any aspect of mechanical engineering not longer than 500 words, including one or two figures, will be published in this section as soon as possible after approval.

Items should be submitted to ASME Divisions and Committees for review in the same manner as technical papers. Only those notes recommended for publication by the reviewing agency will be forwarded to the Editorial Department.—Editor.)

▶ Extended Heat-Transfer Surface

A STRUCTURAL element which is finding increased application is the panel composed of two plates with a honeycomb reinforcement between. The hexagonal cells are attached to the plates by brazing or gluing. In regard to heat transfer, each plate serves as an extended surface between the cell walls and the ambient. For purposes of heat-transfer calculation one must know the efficiency of the plate surface, regarded as a fin.

Not finding a solution for this case in the literature, G. M. Dusinberre, Fellow ASME, of the Department of Mechanical Engineering, The Pennsylvania State University, University Park, Pa., arrived at the following:

$$\phi = \frac{2}{N}\frac{I_1(N)}{I_0(N)} \qquad [1]$$

where ϕ = fin efficiency
I = modified Bessel function of first kind
$N = r\sqrt{h/ky_b}$ (dimensionless)
r = radius (any consistent units)
h = surface coefficient (any constant units)
k = conductivity (any consistent units)
y_b = plate thickness (any consistent units)

Subscripts denote order of the Bessel function.

The term r is the radius of a circle "equivalent" to the hexagon, say a circle having the same perimeter. (The true hexagonal shape is in any case usually distorted in the process of manufacture. An error in this term will have little effect, since the efficiency should be applied to the actual area in the final calculation.)

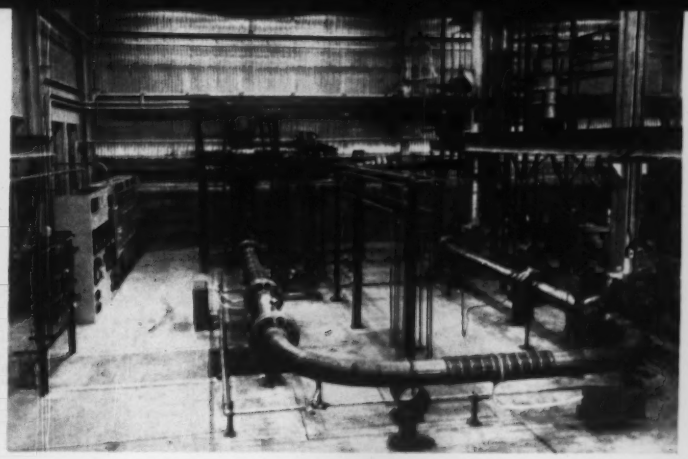
K. A. Gardner of The Griscom-Russell Company, Massillon, Ohio, has pointed out in a private communication that the asymptotic form, accurate within 2 per cent up to $N = 1.5$, is

$$\phi = \frac{8}{8 + N^2} \qquad [2]$$

The writer finds that the following empirical expression is accurate within 1 per cent up to $N = 2$:

$$\phi = \frac{9}{9 + N^2} \qquad [3]$$

Miniaturized low-priced atomic-energy reactor for school, medical, and industrial use



Test loop to simulate the slurry flow conditions for the P.A.R. by the Atomic Power Department of Westinghouse

Nuclear Briefs

▶ Laboratory Reactor

A MINIATURIZED low-priced atomic energy reactor has been designed by Atomics International, a division of National American Aviation, Inc., for school, medical, and industrial laboratories.

Only 8 ft high and 8 ft in diam, the 5-watt "Laboratory Reactor" can be installed on a short delivery schedule in any building without the addition of any special facilities. It is controlled by a single operator.

The "core" of the reactor, where atomic fission takes place, is a 1-ft stainless-steel sphere containing about 4 gal of enriched uranyl sulfate in a water solution. The core, surrounded by a 6-in-thick lead shield, is housed in an 8-ft tank filled with ordinary water. A number of exposure facilities and beam tubes are provided to permit several experiments to be carried on while the reactor is operating.

▶ Slurry Test Loop for P. A. R.

A test loop under construction at the atomic power department of the Westinghouse Electric Corporation will simulate slurry flow conditions for the Pennsylvania Advanced Reactor, P.A.R.

When completed, the loop will circulate slurry at P.A.R. reactor pressures, temperatures, and concentrations, at a flow rate of 4000 gpm, half the flow rate required in each of the four loops of the ultimate plant. This facility will permit the testing of the interaction of high and low-pressure systems, methods for concentration control, and methods for complete filling and draining of the plant.

Jointly sponsored by Westinghouse and the Pennsylvania Power and Light Company, the project will make experimental and analytical studies leading to the design of an aqueous homogeneous reactor plant having an electrical output of 150,000 kw. This plant is to operate on the PP&L system in Eastern Pennsylvania.

Materials Briefs

▶ Titanium Not Harmful to Lubricants

TITANIUM and its alloys should have no harmful effect on the long-term storage life of lubricants, according to results of limited tests by the Army. The experimentation is described in a report released through the Office of Technical Services, U. S. Department of Commerce.

Most bearing metals and alloys in storage contact with grease and oils for long periods act as catalysts in accelerating oxidation or chemical decomposition of lubricants. Badly oxidized lubricants impair bearing performance and may cause corrosion of metallic components. Prior to this research no data could be obtained on the catalytic effect of titanium on lubricants.

It was shown that the metal and its alloys exert only a very slight catalytic influence in increasing the oxidative breakdown of lubricants complying with MIL-G-3278, AXS-1169, and MIL-O-6085A. Copper showed a pronounced catalytic effect. The titanium grades used were RC-70, Ti-75A, and RC-130A. They were tested by the Norma-Hoffman Oxygen Bomb Method.

The 25-page report, PB 131106 may be ordered for 75 cents from OTS, U. S. Department of Commerce, Washington 25, D. C.

▶ Improved Impact Resistance for Cermets

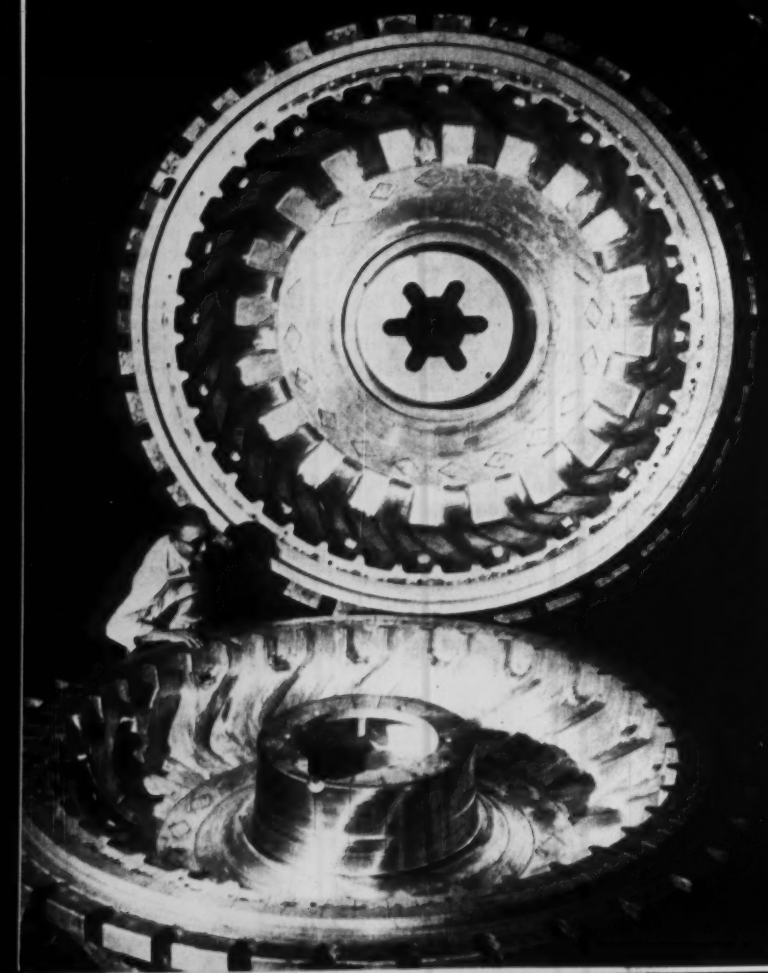
Appreciable improvement in the impact resistance of cermets through application of a ductile metallic coating is reported by an Air Force research contractor, through the OTS, U. S. Department of Commerce.

The research with the K161B-base cermets, for use in gas turbines, was based on the assumption that impact failures originate in surface brittle cracks formed under tensile stresses. Impact resistance could be improved by formation of an integral surface more metallic than the cermet body, and consequently less prone to originate brittle fracture.

Application of 0.018 in. of electro-deposited nickel, bonded by a suitable vacuum heat-treatment, raised the cermet's impact strength from 2.65 and 3.36 in-lb at room temperature and 1800 F, respectively, to values of 21.48 and 18.96 in-lb at the same temperatures. Limited testing indicated that diffusion bonding of shaped tubing also raised impact strength appreciably.

Infiltration of porous sintered coatings showed promising structures, but impact strength was essentially unchanged. Direct application of brazing alloys was unsatisfactory. Vacuum-cast coatings had interesting microstructures, but were not evaluated.

The 33-page report, PB 131093, may be ordered for $1 from OTS, U. S. Department of Commerce.

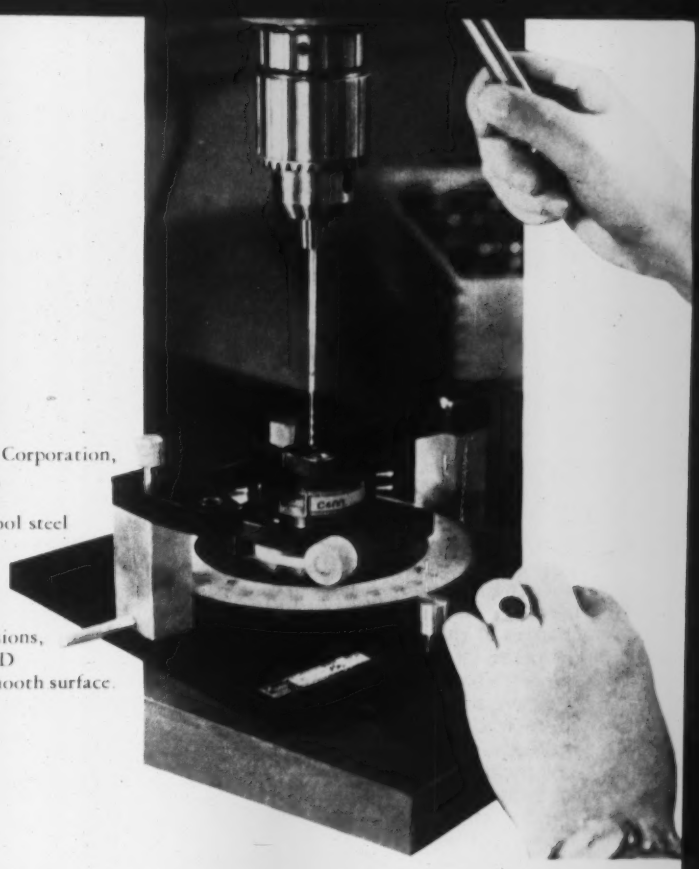


▲ **Damage-Free Gondola.** The extremely high restraining force provided by rugged cross members permits 27 large electrodes to be shipped where limit with the conventional dunnage was about 15. Total weight of this shipment being loaded at the Columbia, Tenn., plant of National Carbon Company was approximately 146,000 lb.

◀ **Mammoth Tire Molds.** These 8-ft 10-in-OD aluminum castings totaling 8 tons in weight were cast by the Aluminum Company of America for Goodyear Tire and Rubber Company. Tires almost $7\frac{1}{2}$ ft in diam and weighing 2500 lb will be cured in them by heating to nearly 300 F for about 6 hr with steam. The mold is closed with a crane, and a 48-in diam hydraulic ram, operating at 1600 psi, holds the halves together.

Miniature Drill Extension

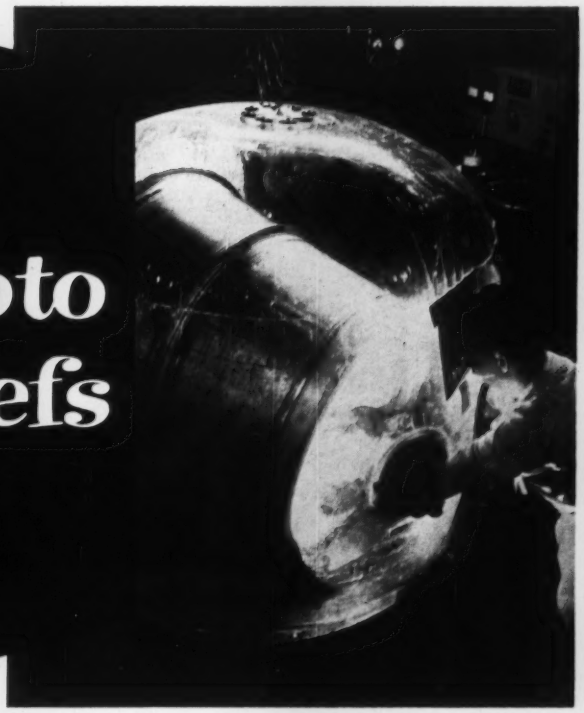
The "Mindril" manufactured by the Ritmar Corporation, Huntington, L. I., N. Y., is a miniature drill extension made of heat-treated high-grade tool steel of 1/8 in. OD, which may be ordered for any individual drill size from 0.0135 to 0.0043 in. It offers greater concentricity than is obtainable with soldered drill extensions, and may be used with a 1/4-in-ID bushing because of its uniform OD and smooth surface.



Inert-Gas Welding. A "Krene" cast-vinyl plastic bubble, fabricated by Pioneer Valley Plastics Company, Chicopee, Mass., from the Bakelite Company product serves as the inert-gas enclosure for welding titanium engine-parts at the Pratt & Whitney Aircraft plant, protecting the weld from impurities. Argon gas piped into the 4-ft-high 4-ft-diam welding tent forces atmospheric air out through several small valves at the top of the tent and keeps it inflated. The welder works through sleeves, viewing the work through a protective shield.

Nuclear Fuel Charge. The recently installed 58-ton nuclear core for the first full-scale nuclear power plant at Shippingport, Pa., contains 14 tons of natural uranium and 165 lb of highly enriched uranium. Westinghouse is building the reactor for the joint AEC-Duquesne Light Company project.

Photo Briefs



European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

The Engineering Exhibition, London

WHAT is generally known in London, England, as "the Engineering Exhibition," held this year from August 29 to September 12, is one of the longest-established events of its kind in the British Isles, if, indeed, it is not the oldest. Started in 1907 as the Engineering and Machinery Exhibition, it later developed into the Engineering and Marine Exhibition. There have been other changes of title as its scope has been widened to take in other branches of engineering, or, in some instances, altered because some subdivisions of the industry have set up their own exhibitions. This year, for the first time, it blossomed out as "The Engineering, Marine, Welding, and Nuclear Energy Exhibition." The inclusion of nuclear energy in the title was justified, for more than 40 per cent of the 500 or so exhibiting firms could claim some connection with the program of atomic power-station construction in the United Kingdom. The 1957 Exhibition was hailed at the opening luncheon as a "coming of age," being the 21st of the series; for, though 50 years have elapsed since the first, and it is supposed to be held in alternate years, the two World Wars caused four of the Exhibitions to be abandoned. The official opening was performed by Sir Christopher Hinton, managing director of the Industrial Group in the United Kingdom Atomic Energy Authority, who said that by 1965 "a very large proportion" of the power stations to be built in the United Kingdom would be nuclear. He spoke with authority, as from January 1 the responsibility for constructing new power stations will be taken over from the present Central Electricity Authority by a new organization, the Central Electricity Generating Board, which Sir Christopher will head.

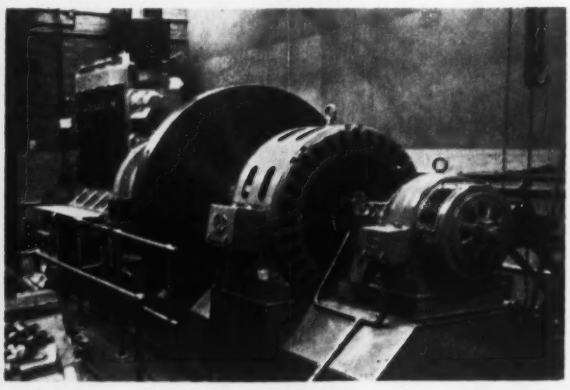
Alternator Set for Stand-by Power Supply

AN INTERESTING exhibit at the Engineering Exhibition was an alternator set, driven by a three-cylinder oil engine, shown by Blackstone and Company, of Stamford, Lincolnshire, England, and designed for use in hospitals or other establishments where continuity of power supply is essential. The engine was a Lister-Blackstone type EV3 four-stroke diesel developing 135 bhp at 600 rpm and coupled through a large separate flywheel to an 85-kw alternator delivering three-phase 50-cycle current. The flywheel was 5 ft 9 in. diam and weighed, with its shaft, about four tons. It was coupled to the driven shaft through an air-operated friction clutch. Between the clutch and this heavy flywheel was a flexible coupling and a nodal damper to absorb torsional vibrations in the shafting. While current is passing normally, the alternator acts as a synchronous motor and drives the flywheel. If, however, the current fails, two electromagnetic air valves come into action to operate two pneumatic rams connected to the clutch engaging mechanism. The momentum of the flywheel is then sufficient to start the oil engine, which quickly picks up speed and drives the alternator. Linked with the changeover mechanism are the necessary controls of the fuel and the starting air, and an automatic synchronizer to enable the alternator to be paralleled with the main supply. When the main current comes on again, the engine is automatically disconnected from the independent flywheel and the fuel pumps are cut off, bringing the engine to rest.

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

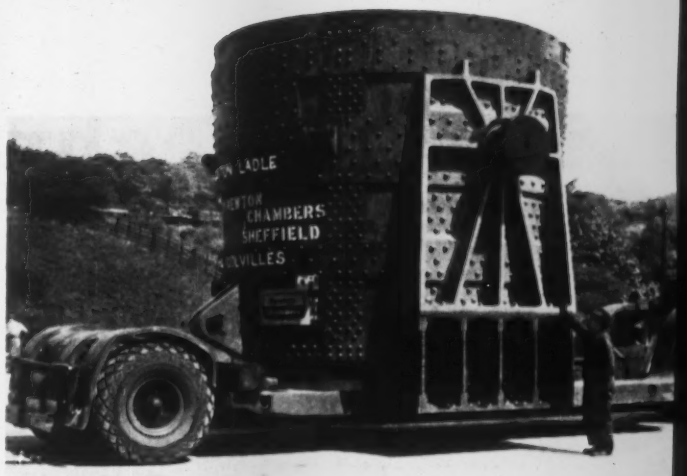
Engineering, Marine, Welding, and Nuclear Energy Exhibition held August 29–September 12, 1957, Olympia, England

Lister-Blackstone 85-kw "no-break" alternator set designed for use where continuity of power supply is essential



250-Ton Ladles for Scottish Steelworks

The new Ravenscraig steelworks of Colvilles Limited, the Scottish steelmakers, is now nearing completion and deliveries have begun of eight 250-ton ladles, the largest yet made in the United Kingdom. It stands 14 ft 8 in. high and is only $^1/_2$ in. less than that in diam at the top. The net weight unlined is 60 tons, and the total weight, lined and full of steel, is 340 tons. The makers are Newton, Chambers and Company, Thorncliffe, near Sheffield. The Ravenscraig steelworks is near Glasgow and the ladles are being transported there by road, a distance of about 240 miles. Fourteen similar ladles are on order for another steelworks, that of John Summers and Company, near Chester, England. These will not have to be hauled so far—under 100 miles—but the journey may well be even more difficult to plan, as the route passes through some congested industrial areas. There is no alternative to road haulage, as the ladles exceed the loading gage of the British railroads.



The first of eight 250-ton ladles for the new Ravenscraig Steelworks of Colvilles Limited, Scotland. Height 14 ft 8 in.

England and France Linked Electrically

In the December, 1956, "European Survey," page 1147, it was reported that a scheme was under consideration for linking England and France by an electric power cable across the English Channel. The plan has now received the formal approval of the British Minister of Power. It will be about 35 miles long and will consist of two insulated conductors, forming a "go" and "return" circuit. This system is being adopted to avoid possible interference with the magnetic compasses of ships passing over the cables, and also to counteract the risk of electrolytic corrosion of submarine telegraph cables laid in its neighborhood. It is expected that the project will be completed in time to assist with the winter load conditions of 1960-1961. The estimatedc ost will be the equivalent of between $11 and $12 million, excluding the cost of connecting the cables to the existing grids on both sides.

Electric link between Britain and France

Free-Piston Engine

Both the Free Piston Engine Company and the Brush Group were showing free-piston engines in the Engineering Exhibition in London, that on the latter stand being, it was stated, the first British-made example of this type of prime mover. It was of 1000 hp, as a marine propulsion unit, but was rated at a somewhat higher power if employed to drive an electric generator on land. The engine cylinder diam is 13.4 in. and the diam of the compressor cylinder 35.5 in.; with a common stroke of from $15^3/_4$ in. to about $19^3/_4$ in. (400 to 500 mm). The gas delivery is 8.8 lb per sec at 42.6 psig and 825 F. This unit was built by the National Gas and Oil Engine Company (one of the companies in the Brush Group) and was designed to be used, singly or in conjunction with others, up to a total of ten, to drive a gas turbine. The Brush Electrical Engineering Company showed such a turbine on the same stand, a multistage axial-flow machine of 3000 shp with reaction-type free-vortex blading, to extract the maximum amount of useful work from the relatively low temperature and pressure gas discharged by a Pescara-type free-piston engine.

Exhibit of the Brush Group Limited in the National Hall of the Engineering, Marine, Welding, and Nuclear Energy Exhibition. *Center,* right of tubular stanchion, 1000-hp free-piston gasifier; *right of that,* 3000-hp gas turbine designed to be driven by the exhaust from such gasifiers; *left,* 12-cylinder V-type oil engine of 3096 bhp.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Petroleum Mechanical Engineering

Stress Effects of Rotary Straightening on Collapse Resistance of High-Strength Casing, by R. E. Zinkham, Assoc. Mem. ASME, Jones and Laughlin Steel Corporation, Pittsburgh, Pa. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-6** (multilithographed; available to July 1, 1958).

An investigation was initiated to ascertain the origin and consequences of the stress effects, induced by rotary straightening, upon the collapse or external pressure resistance of high-strength casing.

The Sutton 4KTC seven-roll straightener was used in this investigation. It employed two 3-roll clusters, one at the entry end and one at the exit end of the machine, with an unopposed pressure roll mounted between the two clusters. In each cluster there was one large driven roll and two idler or friction-driven pressure rolls positioned at approximately 120 deg to each other.

Straightening was accomplished by bending the tube with the unopposed middle pressure roll plus the rolling action on the tube in the cluster rolls. The middle pressure roll did the majority of the straightening and removed long sweeps. End hooks were removed by the cluster rolls.

Pressure was indicated on large dials on each of the cluster rolls as well as on the middle roll. An adjustment changed the diameter of the circle contained in the cluster rolls and it was recorded on the dials in increments of 0.001 in. A similar arrangement gave a measure of the deflection about the pass line beneath the middle roll.

An analysis of the final results indicates that the following factors are apparent:

1 The deflections or pressures produced by the cluster rolls of the Sutton rotary straightener have shown a direct relation to the induced tangential residual stresses and a consequent decrease in collapse resistance of the casing.

2 The influence of the residual stresses and cluster-roll deflections had a lesser effect upon the collapse resistance of the casing as the wall thickness increased for a given size of casing or as the diameter divided by the wall thickness (D/t ratio) decreased.

3 There was a decrease in the longitudinal tensile yield strength of the casing caused, it is believed, largely by the pressure exerted by the unopposed center roll of the straightener. Also this roll apparently relieved a portion of the longitudinal stresses originally existent in the pipe before straightening as well as a portion of the tangential stresses induced by the cluster rolls during the straightening operation.

4 The stress-relief treatment was definitely required in the D/t range above 19 to meet the American Petroleum Institute's minimum collapse standard. There was little to be accomplished from an increase in yield strength in this range because of the phenomenon of elastic instability.

5 Further investigation is necessary in the D/t range 19–16 to establish the requirements necessary for optimum straightening in conjunction with a minimum of induced stresses. The 7-in., 29-lb casing in this range exhibited promising results relative to meeting the specification requirements on a statistical basis if proper precautions are exercised in straightening, as well as yield strength requirement.

6 A stress-relief treatment was not necessarily warranted to meet the proposed American Petroleum Institute's minimum collapse performance properties in the D/t range 16–13 providing certain limitations were observed. The results of this program have indicated that a minimum yield strength of 123,000 psi should be attained. Also a maximum limitation of 0.100 in. deflection or 100 points on the dial of each cluster roll should be observed as well as a maximum deflection of 650 points on the dial of the center straightener roll. In conclusion, it should be stated emphatically that the optimum in collapse resistance is obtained with a minimum of straightener pressure.

Application of Plastic Tape to 122 Miles of 22-In-Diam Natural Gas Pipeline, by Norris E. Miley, American Louisiana Pipe Line Company, Detroit, Mich. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-31** (multilithographed; available to July 1, 1958).

Plastic tape materials and their application, together with protective overwrap, for large-diameter pipe are the subjects of this paper. Plans for checking the service life of the material are presented along with the cost of application and the savings that can be realized through the use of this new plastic material.

The material chosen for the installation of the 22-in-diam line was a plastic tape coating material with an over-all thickness of 12 mils—8 mils of polyethylene film and 4 mils of adhesive. The material was provided in 15-in-wide rolls, 800 ft long. Specifications required that a 20-mil thickness of tape having 15 mils of polyethylene film and 5 mils of adhesive should be used on all water crossings, swamp crossings, railroad, and road crossings where a double-wrapping specification would be required with the conventional-type coating used elsewhere on the system.

A cathodic protection test for checking service life of the plastic tape coating was installed.

As a result of employing the plastic tape, a reduction in manpower and equipment and greater daily efficiency were the key economic contributions realized.

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Development and Application of High Density Asphalt Mastic Coating, by L. N. Brown, Southern Natural Gas Company, Birmingham, Ala. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-29** (multilithographed; available to July 1, 1958).

Timcoat, a combination protective and weight coat to be used on pipelines laid primarily in marsh, swamp, and offshore areas, is discussed in this paper.

Development of the material proceeded from a need for a coating that had flexibility and ductility and could be applied to the pipe on location immediately prior to laying.

After several years of experimentation, it was found that a combination of base asphalt refined from salt-free crude, a coarse aggregate of sand and/or heavy weight material, a mineral filler, a binder of emulsified asphalt mixed with hard asphalt and synthetic rubber, an internal reinforcement of chopped fiberglas strands, and an external reinforcement of fiberglas mesh furnished the type of coating that was sought.

The weight of the coating mixture can be varied between 136 and 230 lb per cu ft by blending the proper proportion of light and heavy-weight aggregates.

Tests have shown that the dielectric strength of the rubberized asphalt is about twice that of coal tar and that it compares favorably with all of the commonly used insulating materials except chlorinated rubber. It exceeds vinyl, hard rubber, and asbestos-filled Melamine resin.

The addition of synthetic rubber to the coating tends to increase the adhesive qualities of the binder with respect to the aggregates and of the over-all coating with respect to the pipe surface.

The coating machine is mounted on a self-propelled car that moves on rails and carries a flame dryer and a cleaning machine. This equipment extends over a distance of about 16 ft in which length the pipe is flame-dried, cleaned, and coated. The car also carries a hopper for the hot mixture from which it is fed by gravity into the high-pressure extrusion pumps of the coating machine which force the coating on the pipe.

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Mobile and Fixed Platforms for Waters up to 600 Ft, by R. L. Le Tourneau, R. G. Le Tourneau, Inc., Longview, Texas. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-11** (multilithographed, available to July 1, 1958).

REQUIREMENTS—basic and technical—for mobile and fixed platforms capable of drilling in waters 100 to 600 ft in depth are presented in this paper.

A discussion of the versatility requirements of the "ideal" platform contains comments on the variable depth of the wells and whether they are to be exploratory or development wells. Multiple wells from mobile platforms, and combination drilling platform, and elevated construction barges are also discussed in this section.

In a section of the paper on design criteria for the "ideal" platform, supporting structure design considerations are given in addition to comments on soil conditions, wind and wave forces, stability afloat and on location, and speed on location.

Answers are submitted to such problems as: Multiple wells from a single platform for development operations, probable costs of units designed for waters up to 300 ft, spud penetrations and footing for various soils, equipment obsolescence, and other platform factors pertinent to opening new offshore areas.

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A Pressure Gradient Sheet for Rating Gas Pipelines, by J. R. Berry, United Gas Pipe Line Company, Shreveport, La. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-27** (multilithographed, available to July 1, 1958).

GAS pipeline companies operating for many years over thousands of miles of pipelines have been carrying gas at pressures dictated by delivery requirements of their customers and at pressures well within the piping code requirements. For the most part, these lines have been operating at pressures considerably lower than the design values, but during peak delivery periods they are frequently operated at slightly higher pressures although still well within the piping code requirements.

For many years, pipelines were constructed on the basis of pipe strength set by the pipe manufacturing companies. These pipe-strength values were based on comparatively large safety factors. Improved processes of steel manufacture and better welding practices in making pipe of plate and in joining lengths of steel pipe have resulted in stronger and more uniform quality pipe. Pipelines are now designed for specific pressure conditions according to accepted standards.

This paper describes a system of pressure gradient sheets which would provide assistance in rating gas pipelines and planning the transmission of natural gas. The system may be used to some extent in designing extensions.

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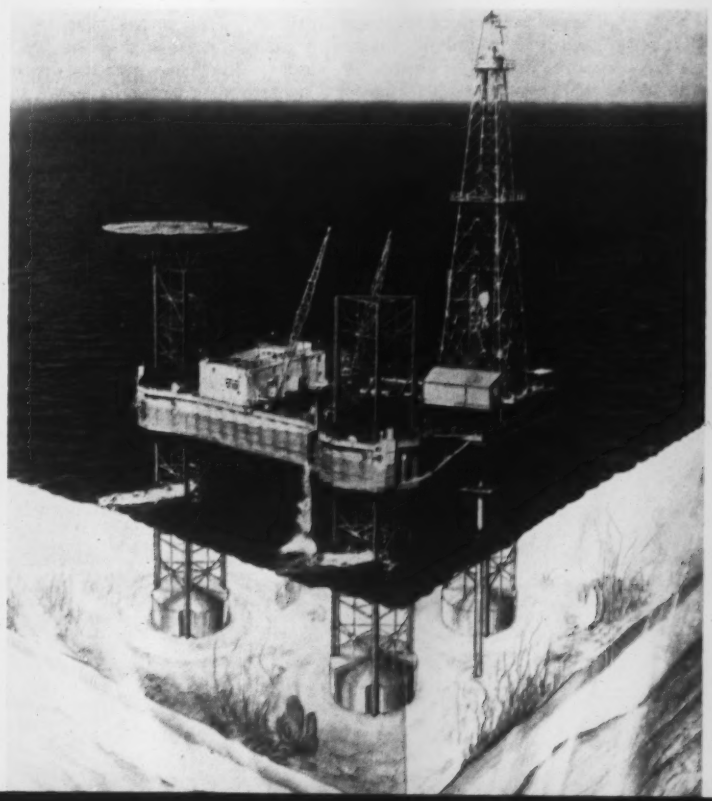
Modernizing Compressor Station Piping, by M. J. Paul, Mem. ASME, Natural Gas Pipeline Company of America, Chicago, Ill. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-13** (multilithographed, available to July 1, 1958).

NATURAL Gas Pipeline Company of America in 1929 and 1930 constructed the first long-distance large-diameter high-pressure natural-gas-transmission pipeline from the Panhandle field of Texas to the terminus at Joliet, Ill., a distance of 847 miles. To maintain flow efficiency, one field station and nine compressor stations were constructed. One additional field station and one mainline station were added later on as flow rates were increased. These stations are all self-sufficient, having their own electricity, fuel, and water facilities, a separate communications system between stations, and living quarters for all key operating personnel. They were constructed to incorporate the latest engineering thinking of that day and op-



Tripod open-truss construction of Zapata Offshore Company's vinegarroon

erated as efficiently as could be expected from equipment then in service.

This paper reviews the following more important modernization programs undertaken by the Natural Gas Pipeline Company of America: Remotely controlled blowdown systems; modified closed water-cooling systems; supercharging compressor engines; exhaust tuning of auxiliary engines; exposure of manifold piping. Each program is described in broad terms, which include the reasons that the individual projects came into being, the scope of the work undertaken in each project, and the resultant effect on operating conditions.

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Two-Phase Concurrent Flow of Liquids and Air Through Inclined Pipe, by W. E. Brigham, E. D. Holstein, and R. L. Huntington, University of Oklahoma, Norman, Okla. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-14** (multilithographed; available to July 1, 1958).

THE research project reported in this paper was undertaken for the purpose of studying the effect of up and downhill flow on pressure drop. Recent field results show that excessive pressure drops have been encountered in two-phase pipelines through hilly country.

Experimental equipment for the project consisted of a double loop of 1.975-in-ID clear plastic (Tenite) tubing mounted on an angle iron frame which could be adjusted to various inclines. Orifice and displacement meters, pressure gages, U-tube manometers, and thermometers were used to measure the flow variables. The over-all length of the test loop was 27 ft and there were 97 ft 2 in. of straight pipe in the test section. The equivalent length of the test section, including bends was found to be 124.5 ft. Since the surges were very great with slug flow, it was necessary to install buffers in the manometer lines to make the readings more stable. The buffers consisted of small surge tanks with the inlet and outlet leads packed with steel wool. The packing technique was difficult to develop since the packing had to be tight enough to lessen the pressure surges but not enough to impair the true manometer reading.

Data were taken using No. 10 SAE lubricating oil or water as the liquid phase, and air as the gas phase. The density of the No. 10 SAE oil at 83 F was 53.9 lb per cu ft and its viscosity was 70.4 lb per ft-hr. During the experimental runs the maximum range of temperature was not enough to affect appreciably the density or viscosity of either the oil or the water. The slopes used were 12.4, 5.5 deg, and horizontal.

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An Investigation of Pressure Drop Through a Rotating Pipe, by H. Ferrell, E. C. Fitch, and J. H. Boggs, Assoc. Mem. ASME, Oklahoma State University, Stillwater, Okla. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-9** (multilithographed; available to July 1, 1958).

RECENT developments in petroleum drilling have enabled greater penetration depths than would have been thought possible a few years ago. With the greater depth of present-day drilling have come increased problems of circulation. One of these problems is the tremendous power requirement of the circulation system. This means that an accurate prediction must be made of this requirement. Much work on the detailed consideration of hydraulic losses has been done to analyze the effect of various types of drill stems and tool joints as well as the effect of bit nozzles. Some work also has been done considering the losses caused by the circulation fluid itself. However, a detail which practically has been overlooked in the consideration of hydraulic losses is the effect of pipe rotation.

This work reports a study of the pressure-loss characteristics of water flowing through a rotating pipe. The results showed that the pressure drop was reduced, reaching a minimum value, as the angular velocity of the pipe was increased. A dimensional study revealed that the pressure loss was equal to the pressure drop for laminar flow times a function of Reynolds number, the ratio of angular momentum to viscosity, and the length-to-radius ratio. Extrapolation of the result, by dimensional analysis, to fit the circumstances of oil-well drilling, indicated that a significant pressure-loss reduction may be achieved by increasing the rotary speed.

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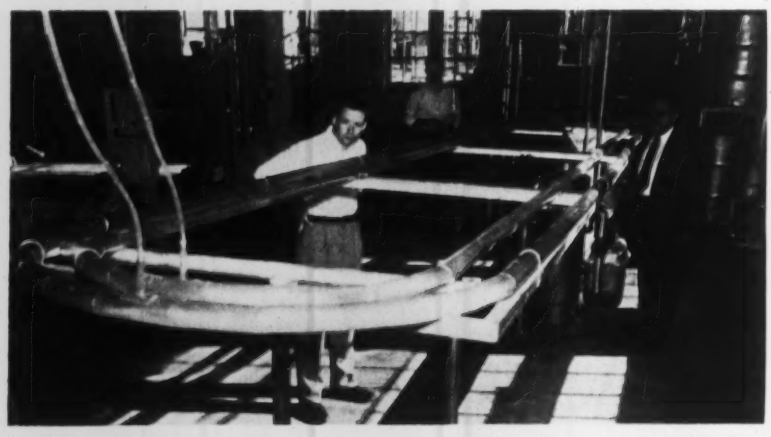
Automatic Production of Oil From Wellhead to Pipeline, by E. C. Young, Assoc. Mem. ASME, Black, Sivalls and Bryson, Inc., Oklahoma City, Okla. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-22** (multilithographed; available to July 1, 1958).

MANY industries where final products must meet rigid specifications have turned to the use of automatic control. The use of automatic control has resulted in increased operating efficiency, less spoilage, and a better quality finished product. It is therefore natural that oil companies operating leases where the production to the pipelines must meet rigid specifications, and where production allowables are controlled by State Regulatory Commissions, consider using automatic control of lease operation.

Several factors are involved in automatically producing a lease, and it is the purpose of this paper to cover the various operating functions which must be considered in setting up a lease for automatic controls. Included in the discussion will be the equipment required for wellhead control, well test and flow control, and automatic tank switching and automatic custody transfer. Automation of each lease must be considered individually. It is impossible to say that all leases require certain types of automation equipment. The purpose of this paper is to serve as a guide in selecting proper automation equipment for a particular lease. The economic justification for automatic lease operation will not be discussed, since this must also be



Apparatus used in experimental work to study the effect of up and downhill flow on pressure drop

done on an individual basis for the lease concerned.

In considering automation from wellhead to pipeline the following factors must be noted:

1 It is always necessary to start at the wellhead. All subsequent controls are based on shutting the system in on the upstream side and must ultimately end with shutting in the well.

2 All controls and valves must have fail safe features so that in the event of failure, lease will be shut in.

3 All control valves must have tight shutoff. Shut-in wells must not leak since leakage will create pressure build up in the flow lines. In well testing the 3-way valve must shut off the flow to production and route all flow to test to insure accurate results. All lease automatic custody transfer values must have tight shutoff to prevent leakage into the meter while the meter is on the pipeline, and must have tight shutoff between the meter and the pipeline when the meter is filling.

4 All electrical controls must be simple in operation. It is advisable that the components be the plug in type to facilitate removal by field personnel. The control panels should be protected from atmospheric conditions and should be designed for 115-volt operation.

5 All metering equipment for well testing must have good repeatability and accuracy within ± 1 per cent.

6 Custody transfer systems must be foolproof and must fulfill the requirements as specified by the oil pipeline companies. They must also satisfy the regulations set out by the State Regulatory Commissions.

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Overstrain and Bursting Strength of Thick-Walled Cylinders, by S. M. Jorgensen, Foster Wheeler Corporation, New York, N. Y. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-4** (multilithographed; to be published in Trans. ASME; available to July 1, 1958).

Rapid expansion of the chemical and allied industries into the high-pressure field has presented the vessel designer with a number of new problems. One of the most important of these problems is the selection of a proper design formula and strength criterion. In the design of thick-walled cylinders the technical literature of today and responsible manufacturers consider only two strength criteria of the many available: The shear stress theory, and von Mises' strain energy theory.

In this paper a description is given of the stress distribution in elastically strained and partially overstrained thick-walled cylinders. A method of determining the most advantageous degree of overstrain is presented. Ultimate strength is discussed and an empirical formula for the bursting strength is proposed.

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Scheduling Engineering Design—A Vital Force in Refinery Operations, by H. T. Campbell, Mem. ASME, Humble Oil & Refinery Company, Baytown, Texas. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-3** (multilithographed; available to July 1, 1958).

The establishment and maintenance of an effective engineering design schedule in a large refinery are a task that merits the co-operation and understanding of all concerned. There are many factors working against adherence to predicted completion dates. Despite the most sincere efforts, there will be many cases where man-day requirements will exceed the original estimates. There is constant pressure from project engineers, operating people, and from management to improve dates or to establish dates that past experience might indicate to be unreasonable. The unanticipated jobs and unexpected additions to projects will continue to contribute to the dynamics of the over-all problem. As long as the schedule is used as a guide to determine the timing for and extent of contracting of engineering to outside consultants, then schedules must be made as realistic and accurate as possible. Gross overestimation of man-day requirements or overallowance for the unexpected can easily result in overcontracting and consequent inefficient utilization of company personnel. Scheduling of design work is an important and a challenging problem for refinery engineers.

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Military Petroleum Logistics, by H. N. Darling, Petroleum Division, Office of The Quartermaster General, Washington, D. C. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-12** (multilithographed; available to July 1, 1958).

The Armed Services face many problems in supplying petroleum products to their forces throughout the world; however, these problems have been minimized by the outstanding support and assistance provided by the American petroleum industry. This paper describes military petroleum logistics and the operation of military petroleum pipelines. The scope of military petroleum logistics is perhaps greater than many people recognize. In normal peacetime operations, the Services engage in the development of petroleum specifications for all types of petroleum-consuming equipment; the procurement and inspection of the required products; the distribution of product from refineries to bulk terminals to military bases by nearly every conceivable method. In addition, the planning for war is an ever-present task. The impact of wartime consumption is such that the industry may be hard put to meet requirements; therefore, planning for war must take into consideration all available production, refining, transportation, and distribution facilities. The volumes of oil used in peace and war, how the military procures its petroleum and distributes it throughout the world, Army Quartermaster pipeline operations, and a few of the problems encountered are all considered herein.

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Report on Results Obtained by Use of Controlled Drill-System Torque in Field Operation, by S. C. Moore, Driloo Oil Tools, Inc., Midland, Texas. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-5** (multilithographed; available to July 1, 1958).

One reason that the rotary-shouldered connection has been accepted universally for joining drill-stem members together is its ability to operate satisfactorily through a wide range of makeup torques. Field operations indicate that the connections on tool joints are not ordinarily subject to fatigue failures, and torque control is needed primarily to obtain

Cross section of 4-in-full-hole pin made up in 4 1/2-in. API regular box. Such a connection between drill collars stayed together for entire 7200-ft hole.

adequate make-up to prevent leakage between the shoulders and to limit make-up below the point of permanent deformation. This is a very wide range. Rotary-shouldered connections on drill collars are highly stressed in operation and highly susceptible to fatigue failure. The prestress induced by the make-up torque has great influence on the fatigue strength of the connections, and therefore control of torque for drill collars is of great importance. This has been demonstrated in field operations.

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Torque Requirements for Rotary-Shouldered Connections and Selection of Connections for Drill Collars, by A. P. Farr, Hughes Tool Company, Houston, Texas. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-19** (multilithographed; available to July 1, 1958).

ROTARY-SHOULDERED connections are the tapered, shouldered, and threaded boxes and pins which are used to join drill stem members together. They enable drill stem members to be easily and repeatedly made up and broken out in service and still maintain a shoulder seal which is essential to proper performance.

In the development of the rotary drilling process there has been a continuous history of trouble with rotary-shouldered connections. Connections have been and continue to be reworked or scrapped and discarded because of physical damage in the form of crowned shoulders, lapped threads, broken threads, galled threads, galled shoulders, and broken pins. In many cases these troubles can be traced to improper make-up of the pin and box connections.

This paper shows how a combination theoretical and empirical approach can be used to determine torque requirements of rotary-shouldered connections.

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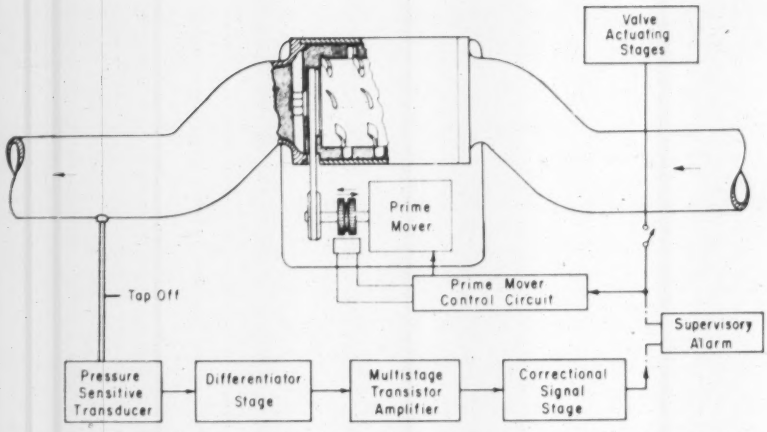
Supervisory Control of Gas Pipelines, by F. Vinton Long, Texas Eastern Transmission Corporation, Shreveport, La. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-15** (multilithographed; available to July 1, 1958).

REDUCED costs and more efficient operation are impelling management to adopt "push-button-operated" pipelines. They must, however, weigh the advantages of reduced operating personnel and increased efficiency of the remaining men against the installation cost of control equipment and the additional safety precautions required with the resulting risk of downtime of remotely controlled compressor stations.

It is also necessary to decide whether it is best to control the entire line and all the compressor stations from a central point or to divide the system into one or more control sections. In either case it is desirable to transmit or telemeter certain vital dispatching information, such as pressures and flow, to a central office in order that the entire pipeline operation may be observed and appropriate dispatching instructions issued.



Typical surge-control device of the type used on "push-button-operated" pipelines

If the line is sectionalized for remote-control purposes, the control centers will receive instructions from the central dispatch office and, through their push-button facilities, control the stations in their section. Each section is complete within itself and, as far as physical control is concerned, might be considered an independent pipeline.

The advantages of this type of operation are considerable. Long communication circuits for control use are not required. Control personnel of each section are nearer to and in closer contact with the stations under their control. Personnel at these control centers can act as backup for emergencies that might occur within their area.

The advantage of controlling the entire system from a central point at the present time is largely confined to reduction of control personnel.

Examples of control and telemetering functions are listed which would be typical of the requirements for remote operation of a compressor station.

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Pressure Surges in Pipelines, by E. J. Waller, Assoc. Mem. ASME, Oklahoma State University, Stillwater, Okla. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-16** (multilithographed; available to July 1, 1958).

PRESSURE surges in pipes are the result of the acceleration of the fluid by the nonuniform motion of a disturbing force. In most pipeline systems the disturbing force is either the plunger of a positive displacement pump or a control valve. In any case, when the fluid is accelerated resulting in a change in velocity with time at a point in the system, the piping system responds with a variable pressure, i.e., a "pressure surge" is created. Basically, the surge problem is one of fluid vibrations in distributed systems under complex exciting forces (pressures).

At the start of the study at Oklahoma A.&M. College there appeared to be two avenues of approach to the problem. One was primarily theoretical in nature and the other primarily experimental. The theoretical approach was chosen. However, certain theoretical results were subject to experimental verification in the laboratory and in the field. These experiments have been carried out and verify the theoretical results for the surges generated by positive displacement pumps in an actual oil pipeline pumping station. The theory verified by tests applies to the continuous or steady-state excitation from pumps. Some laboratory tests involving the transient pressure surge (water hammer) were carried out and show minor discrepancies between the measured values of the attenuation (damping) of the pressure surge and the theoretical values given by other authors.

●

Report on Strength of Welded Joints in Carbon Steel at Elevated Temperatures, by a Special Task Group of the Petroleum and Chemical Panel of Joint ASTM-ASME Research Committee. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-1** (in type; to be published in Trans. ASME; available to July 1, 1958).

THE tendency for high-temperature failures in pressure equipment to take the form of cracks adjacent to welded seams has posed the question, "Is there an inherent weakness in any portion of a welded joint at elevated temperatures?" In an effort to answer this question partially, a Task Group of the Petroleum and Chemical Panel of the Joint ASTM-ASME Research Committee on the Effect of Temperatures on the Properties of Metals has conducted a limited program of testing. Since the high-temperature strength of welded joints is dependent on many factors, both metallurgical and mechanical, it was decided to restrict this investigation to a basic evaluation of the strength of composite specimens including weld, heat-affected metal, and base metal exclusive of any effects of mechanical notches, reinforcement, flaws, undercuts, and so forth. Further, the tests should be conducted on the most common of high-temperature constructional materials; namely, silicon-killed carbon-steel plates. A subsequent phase of the program will consist of similar tests on low chromium-molybdenum steels.

An investigation of the effect of mechanical factors such as notches, weld configuration, and finish on the high-temperature strength of welded structures is being carried out by a Task Group of the Fabrication Division of the Pressure Vessel Research Committee. This investigation consists of uniaxial, static tensile tests on specimens cut from the mid-thickness of welded joints transverse to the weld longitudinal axis. Standard 0.505-in. specimens were subjected to short-time and creep-rupture testing at elevated temperatures.

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Development and Field-Testing of Wire Line Retractable Rock Bits, by J. M. Camp, J. E. Ortloff, and R. H. Blood, The Carter Oil Company, Tulsa, Okla. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-18** (multilithographed, available to July 1, 1958).

DRILLING with casing and collapsible drag bits is not new. Before muds were developed to control heaving shales, this method was used in penetrating such shales in the Gulf Coast and East Texas. This early casing drilling permitted shale sections to be penetrated without pulling pipe to change bits, the casing being carried to total depth and cemented in place.

Drilling with casing and retractable rock bits was analyzed to see if drilling costs could be reduced by this method.

A study of retractable rock bits was started and two different designs were developed. One design used four cutters and the second design was a three-cone bit. The four-cone design was developed and field-tested first. This bit proved to be mechanically sound but, compared with conventional bits, its drilling rate and bit life were not satisfactory. The three-cone bit was built and field-tested. Several minor mechanical adjustments may yet be desirable, but the bit is considered to be mechanically sound. The life of the three-cone bit was 90 per cent of conventional bit life, and drilling rates were equal. Based on this performance and with surface equipment designed for casing drilling, drilling costs can be reduced by perhaps as much as 25 per cent in a 7500-ft hole. Both retractable bits have been licensed for manufacture under nonexclusive contracts.

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Appalachian Basin Air Drilling—Three Years' Experience and Results, by H. J. Magner, Delta Drilling Company, Pittsburgh, Pa. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-7** (multilithographed, available to July 1, 1958).

AIR-DRILLED wells in the Appalachian Basin have been mainly in Pennsylvania, and their average depth is 7200 ft; gas is the production sought. The well in its entirety should be divided into three categories: (*a*) The water string or surface hole, (*b*) the production or gas-string hole, and (*c*) the completion or drill-in hole. This paper discusses the air-drilling techniques employed in each of these categories.

A summary is presented of the air and rig equipment that is employed. Included in this summary are discussions on compressors, airheads, rig engines, rock bits, drill pipe and collars, and miscellaneous rig equipment. Air-drilling practices and problems that are encountered in the production-string-hole operation and in completion-hole techniques are also considered.

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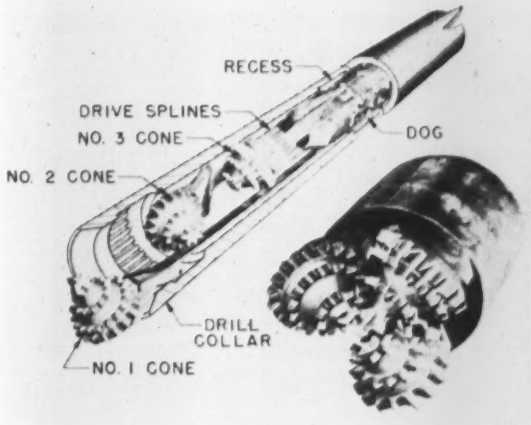
Plastic Pipe in the Petroleum Industry by G. C. Anderson, United States Steel Corporation, Pittsburgh, Pa. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-21** (multilithographed, available to July 1, 1958).

PLASTIC pipe has been used at an ever increasing rate in the petroleum industry. Its greatest use has been in field operations, but manufacturing operations have also employed plastic materials, particularly as these manufacturing operations have expanded into the petrochemical field.

In field operations, plastic pipe has been accepted primarily for its corrosion resistance to the sour crudes in gathering lines, the salt water in disposal systems, and the aggressive soils through which these lines are run. Plastic pipe has relatively good performance with high paraffin crudes. Plastic pipe may be installed with relative ease and at lower cost of installation as compared with metallic and other pipes.

All types of extruded thermoplastic pipes have been used in these services starting with polyethylene and cellulose acetate butyrate. Copolymer styrene and polyvinyl chloride pipes were added as these materials became available.

Plastic pipe has found limited use in the refining and manufacturing aspects of the petroleum industry because of the temperature and pressure limitations of the currently available plastics. Producers have indicated that the greatest deterrent to the further use of plastic pipe is in the difficulty of obtaining satisfactory engineering data for success-



Three-cone retractable bit. Bit is shown, *left,* collapsed in a cutaway view of the special drill collar designed to receive the bit; and *right,* bit is expanded to full drilling diameter.

ful applications. This lack is being met by the preparation of test methods, standards, and material specifications by several bodies including the Society of the Plastics Industry, Inc., American Society of Testing Materials, and American Standards Association. Preparation of installation data handbooks based not only on the technical differences between plastics and older piping materials but on successful field installation of the plastics themselves, is also tending to reduce this deficiency.

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Proved Concepts in Oil Field Roller Chain Drive Selection, by R. A. Schakel, Mem. ASME, and C. O. Sundberg, Diamond Chain Company, Inc., Indianapolis, Ind. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-24** (multilithographed; available to July 1, 1958).

THE concepts outlined in this paper illustrate how dynamic test results are converted to useful practical terms, for predicting roller chain performance in operating drives serving oil field applications at loads and speeds in excess of chain ratings. Due consideration is given to link plate fatigue, maximum permissible sprocket speed, roller life, and wear between the chain pins and bushings in the development of these concepts.

It is shown that the maximum horsepower transmitted at the lower speeds is limited by the fatigue strength of the link plates. Under conditions of higher sprocket speeds, roller-bushing impact strength determines the maximum allowable horsepower. The life expectancy of rollers under such conditions is shown to be a direct function of chain tension and the square of sprocket speed, and an inverse function of sprocket size. Statistical methods are used for analysis of dynamic test data to permit reliable prediction of both roller-bushing life and link plate fatigue strength.

Although the subject of wear is not as well understood as the foregoing factors, correlation of laboratory data with field service information has shown a high degree of reliability and points up the validity of using this approach for such drive applications.

The over-all concepts developed are illustrated in the graph showing the maximum horsepower for $1^1/_4$-in. pitch chain. Operation within the boundaries outlined is expected to provide the predicted service life. Correlations with actual oil field service history are shown as proof of the validity of these concepts.

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Surface-Controlled Subsurface Safety Device for Offshore Locations, by L. M. Wilhoit, Mem. ASME, and P. S. Sizer, Otis Pressure Control, Inc., Dallas, Texas. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-10** (multilithographed; available to July 1, 1958).

ACCELERATED drilling of high-pressure oil and gas wells in inland waters near townsites and dangerous or isolated locations has always required a device to protect wells from uncontrolled flow caused by accident or other damage. Many types of safety valves were built and tried, most of them being of the velocity-valve type. These valves were designed to operate by the additional velocity of flow created by the rupture of some part of the well equipment which would overcome the mass of the valve causing it to close. This type of value was subjected to many inherent variables of flowing wells and made it difficult to calculate and control the closing rate accurately.

Further developments introduced the differentially operated tubing safety valve, the flow-line safety valve, and the pressure-responsive valve. Each of these possessed certain inherent disadvantages in areas where large volumes of flow were permitted.

With the rapid extension of the offshore fields into the shipping lanes of such areas as Lake Maracaibo and the Gulf of Mexico, it became apparent that a safety device must be developed which would afford positive protection for all types of wells located in uninhabited areas, open waters, or navigable channels where storms and other dangers seriously threaten the safety of the wells. To meet the needs dictated by these conditions, a surface-controlled subsurface valve was developed which employed many of the features of both the tubing and flow-line safety valves.

A surface-controlled safety-valve completion had to meet these requirements:

1 The safety valve must be anchored at a safe distance below the lake or ocean floor or land surface so that it would not be subject to sudden strains which might part the tubing string below the safety valve in case of an accident to the wellhead.

2 The safety valve must have a positive action and must not depend upon precalculated closing settings.

3 The safety valve must be designed so that it can be tested and reopened from the surface easily.

4 The safety valve must not interfere with normal completion or production operations. (This requirement is obvious, considering the expense of operating over water or in inaccessible places.)

5 The safety valve must not unduly restrict production rates or flow up to as much as 12,000 bbl per day of total fluid in a 7-in. casing.

6 The safety valve must be adaptable for permanent-type well completions and workovers.

7 The completion must permit production by either tubing or annulus flow. (For wells with thick producing sections and a large PI, annular flow is necessary to produce the well equitably?)

8 The completion must permit either tubing or casing-gas lift.

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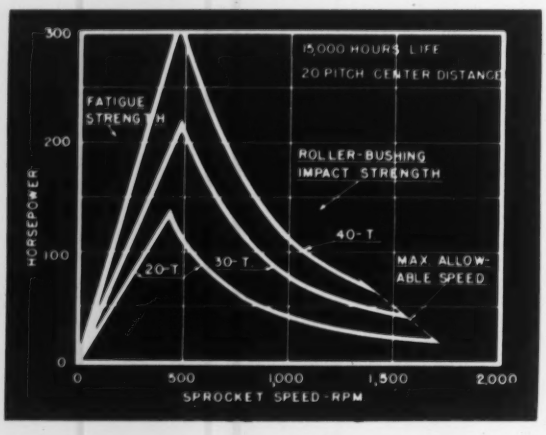
The Economic Aspects of Combustion Gas Turbine Application in the Refining Industry, by C. R. Apitz, Assoc. Mem. ASME, Clark Brothers Company, Houston, Texas. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-20** (multilithographed; available to July 1, 1958).

GAS turbines as a form of power generation are receiving rapid acceptance in a number of fields. These fields include industrial gas turbines for pump, compressor, and generator drives and for use



Maximum horsepower based on fatigue and roller-bushing impact strength $1^1/_4$-in. pitch roller chain no. 100

as hot gas generators for catalyst regeneration in chemical and petrochemical plants. The gas turbine is also receiving acceptance in the fields of automotive power, marine power, and emergency portable power units. Over the last four years, the number of turbines in use throughout the world has more than doubled. The total nameplate rating of the turbines has nearly tripled in power generation installed. Not only are the number of gas-turbine installations increasing but an increasing number of companies throughout the United States are looking into the possibility of further gas-turbine application. Acceptance of the gas turbine is definitely gaining in momentum. The purpose of this paper is to discuss techniques which can be applied in refineries for maximum profit.

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Mechanical Seals for Nonlubricating Hydrocarbons, by A. L. Decker, Assoc. Mem. ASME, Ethyl Corporation, Baton Rouge, La. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-2** (multilithographed, available to July 1, 1958).

SUBSTANTIAL reductions in pump maintenance costs can be effected by improving mechanical-seal life through selection of seals which are especially suitable for the fluids being handled.

This paper presents a brief review of the basic types of mechanical seals and mechanical-seal installation considerations preliminary to a discussion of the factors involved in the selection of an improved seal for a particular group of nonlubricating hydrocarbon services. The study and test program leading to the selection of the improved seal is described in the belief that it is typical of that required for the selection of seals for the less common services. The incentive for periodic re-evaluation of existing mechanical-seal applications is shown by the pump maintenance savings achieved as a result of this particular program.

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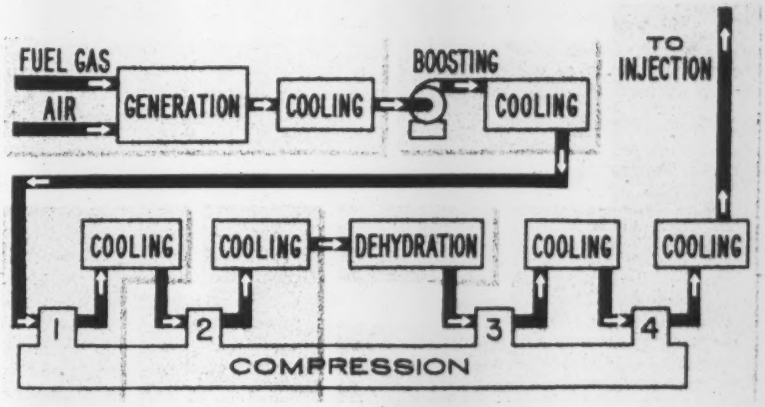
Eight Years of Experience With Inert Gas Equipment, by G. O. Bates, Mem. ASME, and J. W. Kilmer, Pan American Petroleum Corporation, Tulsa, Okla., and H. T. Shirley, Pan American Petroleum Corporation, Powell, Wyo. 1957 ASME Petroleum Mechanical Engineering Conference paper No. **57—PET-34** (multilithographed, available to July 1, 1958).

INERT gas has been generated by the Pan American Petroleum Corporation for the past eight years at its Elk Basin plant. This gas has been injected into the Embar-Tensleep oil reservoir to maintain pressure. The inert-gas system is part of a complete plant which also processes casing head gas to obtain fuel, liquid hydrocarbons, and sulfur.



Elk Basin inert gas system. Pan American Petroleum Corporation has been operating the system for eight years.

The system is composed of equipment serving four purposes: Generation, cooling, compression, and dehydration. Approximately 15 million standard cu ft per day of inert gas is generated in a modified gas-fired water-tube boiler. A booster blower delivers the inert gas from the generator through coolers to the compressors at a pressure of about $^1/_2$ psig, and 80 F. From there the gas is delivered by two stages of compression, with interstage coolers and scrubbers, to a solid desiccant-type dehydration unit at 130 psig and 80 F. The dehydrated gas is then delivered by two stages of compression, with interstage and aftercooling, to the field injection piping system at 1500 psi and 165 F. All compression is done with five 4-stage 1200-hp (sea-level rating) right-angle, 2-cycle gas-engine-driven compressors. One of them is designed and connected for alternate service as a feed-gas compressor.

Eight years of operating experience indicate that equipment handling inert gas will give little more trouble than equipment handling sweet natural gas if the following precautions are followed in the design and operation of the equipment:

1 Adequate combustion and recirculation controls are provided and properly maintained.

2 The gas is dehydrated at the earliest practical location in the system.

3 Pockets where condensate can collect are minimized.

4 pH of condensate is adequately controlled with ammonia.

5 The system is carefully watched for leaks and corrosion.

6 Aluminum tubes are used in cooling equipment upstream of the first stage of compression.

Heat Transfer

Control of Flow Distribution by Mixing Headers, by S. C. Hyman, A. R. Gruber, Assoc. Mem. ASME, and L. Joseph, Nuclear Development Corporation of America, White Plains, N. Y. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-30** (multilithographed, available to June 1, 1958.)

THE coolant flow distribution among parallel passages in a nuclear reactor (or boiler or heat exchanger) can be very sensitive to variations in heat input, channel dimensions, and the like. In a previous paper this flow sensitivity was defined in terms of certain partial derivatives. These terms were related by analytical expressions to fluid properties and operating characteristics. The flow sensitivity is of great concern owing to the potential malfunction, reduced efficiency, or failures that can result. The use of valves and orifices was quantitatively evaluated for supercritical water in the earlier paper.

The scope of this paper is to consider the utility of mixing headers. These mixing chambers are located along the flow passage as a common receiver for parallel flow from many channels. These headers, in turn, supply subsequent lengths of heated passages in parallel. Analytical expressions are derived for the effect of headers on flow, outlet-fluid enthalpy, and channel-wall temperatures. The limiting cases of minimum and com-

plete mixing in the headers are considered. Numerical results for water at supercritical pressures are given to show the marked increase in stability obtained using intermediate mixing headers.

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Natural Convection Heat Transfer in Regions of Maximum Fluid Density, by R. S. Schecter, University of Texas, Austin, Texas, and H. S. Isbin, University of Minnesota, Minneapolis, Minn. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-25 (multilithographed, available to June 1, 1958).

CONVECTIVE heat transfer is greatly influenced by the presence of a density maximum in the convecting fluid. An insight into the mechanism of natural convection in the region of maximum fluid density may be achieved by studying the fluid velocity within the boundary layers.

The density maximum leads to two convective mechanisms, each of which must be considered separately. These two convective regimes have been termed normal or unidirectional convection and inverted convection.

Those conditions which produce dual convection currents are termed inverted convection regimes and the cases in which only a falling or a rising film occur are called normal or unidirectional convection regimes.

In this paper, a test is described which was devised to predict the type regime which will prevail for a heated, flat, vertical plate.

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Heat Transfer From Superheated Vapors to a Horizontal Tube, by G. Balekjian, Alhambra, Calif., and D. L. Katz, Mem. ASME, University of Michigan, Ann Arbor, Mich. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-27 (multilithographed, available to June 1, 1958).

CONDENSATION of superheated vapors is frequently encountered in industry, vapor leaving compressors is one such example. A superheated vapor in contact with a surface at temperatures below the dew point of the vapor will form a condensate film on the cold surface. The heat extracted from the vapor passes through the liquid film much as in the condensation of saturated vapors. The difference in the condensation of superheated vapors from the process for saturated vapors lies in the removal of the superheat from the vapor at an extremely short distance from the condensate surface and the effect which this process has on the temperature of the liquid at the vapor-liquid interface. The proper design of a superheated vapor condenser requires the formulation of a theory whereby the behavior of superheated vapors may be predicted for a wide range of pressures and superheats, in order to anticipate the peculiar condenser condition when the tube surface is no longer wetted with a liquid film.

Experimental data are reported for condensing Freon-114 (tetrafluorodichloroethane) and steam at several pressures. The condition of the vapors ranged from saturation to 180 F of superheat. The condensing tube containing embedded thermocouples was $^3/_4$ in. diam and 3 ft long. Visual observation showed that steam condensed by dropwise condensation in part. Increase of superheat in the vapor at constant pressure caused a lowering of the tube-wall temperature which was indicative of a lowering of the surface temperature of the condensate. The lowering of the condensate-surface temperature below the saturation temperature was computed from the experimental tube-wall temperatures, the heat flux, and Nusselt's equation for the condensate-film resistance. The lowering of the condensate-surface temperature is correlated with degree of superheat. An interfacial film coefficient of heat transfer between the superheated vapor and the condensate surface is reported based on the computed surface temperatures. Schrage's analysis and equations for relating mass and heat transfer with conditions at an interface were simplified and used to correlate the experimental condensing load with the degree of superheat.

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Horizontal Condenser Theory—Part I, Mathematical Development of Tube Loading, by D. Q. Kern, Mem. ASME, D. Q. Kern Associates, Cleveland, Ohio. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-28 (multilithographed, available to June 1, 1958).

THE comparison of performance between large horizontal condensers employing bare and low-finned tubing has amplified several deficiencies in current condenser theory. Among these are the lack of equations which define the average tube loading for conventional tube layouts bounded by a circle. Also lacking is a criterion which establishes the transition from viscous to turbulent flow in terms of the average tube loading. The equations derived in this paper for tube loading are applicable to both bare and low-finned tubing condensers.

The availability of low-finned tubing, tubing having dimensions comparable with bare tubing and possessing fins $^1/_{16}$ in. high, greatly facilitates the further development of condenser theory. For bare tubes the surface per linear foot is proportional only to the outside diameter of the tube. With low-finned tubes on the same layout, a wide variation in surface and condensate drainage can be attained without a significant change in the vapor flow distribution.

The common method for correlating bare-tube data employs the equation derived by Nusselt for condensation on a single horizontal tube with the condensate in viscous flow. Nusselt also derived an equation for computing the condensing coefficient for any horizontal tube in a vertical bank employing the same assumptions. For the pth tube from the top the equation for the condensing coefficient is $h_p = h_1[p^{3/4} - (p-1)^{3/4}]$ where h_1 refers to the value of the coefficient computed for a single tube.

Nusselt assumed that:

1 The resistance to condensation is the resistance of the condensate film to conduction.

2 The temperature difference between the vapor and tube wall is constant.

3 The condensate moves about the tube in viscous flow.

4 The condensate descends from one tube to the tube below as a continuous sheet without disturbing the condensate on the tube below.

Although the Nusselt theory has been found invalid for a vertical bank of tubes it remains the basis for designing horizontal condensers containing a multiplicity of such banks. Equations for condensate loading are derived for the common tube layouts bounded by a circle. These equations indicate that the average value of the condensing coefficient should vary with the size and type of pitch, and that a condition of ideal layout exists which differs from present design practice.

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Wetting Effects on Boiling Heat Transfer—The Copper-Stearic Acid System, by W. B. Harrison and Z. Levine, Georgia Institute of Technology, Atlanta, Ga. 1957 ASME-AIChE Heat Transfer Conference paper No. 57—HT-29 (multilithographed, available to June 1, 1958).

IN ORDER to study effects of wetting on heat transfer in the nucleate boiling regime, stearic acid was boiled in contact with different crystal planes of single crystals of copper. One crystal plane was wetted by the acid and the other was not. In the region of low heat flux, where heat transfer is primarily nonboiling natural convection, the nonwetted crystal required higher values of temperature difference than the wetted

crystal for the same flux. This is consistent with the notion that, for heat transfer without phase changes, nonwetting conditions represent increased thermal resistance. At high values of heat flux, though not in the vicinity of the critical temperature difference, the situation was reversed; that is, the nonwetted surface required lower temperature difference than the wetted surface. This is consistent with the notion that it is easier to form bubbles with nonwetting conditions than it is with wetting conditions.

In the present studies, stearic acid was boiled at about 465 F, corresponding to a pressure of 17 mm of mercury. Heat flux ranged from 3450 to 63,300 Btu/hr sq ft while temperature difference between the copper crystal and the stearic acid ranged from 38 to 132 F. The corresponding range of heat-transfer coefficient was from 91 to 510 Btu/hr sq ft F.

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Heat Transfer and Pressure Drop in Odd-Shaped Annulli, by C. Johannes and R. R. Kraybill, University of Rochester, Rochester, N. Y. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-26** (multilithographed; available to June 1, 1958).

MEASUREMENTS of heat-transfer coefficients and fluid-friction factors were made for water, diesel oil, and SAE 50-60 lubricating oil flowing through a vertical annular brass duct 6 ft long, bounded on the outside by a 1.65-in-sq duct and on the inside by a brass pipe ($^3/_8$, $^1/_2$, and 1-in. sizes). Heat was transferred from the outside surface of the steam-heated pipe to the flowing liquid; the outside wall of the square duct was well insulated. Investigation included Reynolds numbers from 300 to 330,000 and Prandtl numbers from 3 to 1680. Approximately 150 cooling and heating runs were made with heat balances checking within 5 per cent. Heat-transfer data in the turbulent region are best correlated either as a j-factor-type equation or by

$$\frac{h}{c_p G} = 0.015 \left(\frac{c_p \mu}{k}\right)^{-2/3} \left(\frac{D_H G}{\mu}\right)^{-0.2} \left(\frac{b}{D_i}\right)^{(\mu/\mu_W)^{-0.14}}$$

where D_H is the equivalent diameter of the annulus, D_i is outside pipe diameter, and b is the width of the square duct. The pressure-drop data for turbulent flow are correlated by the following equation

$$f = 0.06 \left(\frac{D_W G}{\mu}\right)^{-.20} \left(\frac{b}{D_i}\right)$$

Data for the laminar region are represented by graphical correlations for f and h. The divergence between Colburn's j-factor and $^1/_2$ of the friction factor ($f/2$) is noted and discussed. The recommended equations fit the data with a maximum deviation of about 20 per cent.

●

Momentum and Mass Transfer by Eddy Diffusion in a Wetted-Wall Channel, by A. M. Dhanak, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-32** (multilithographed; available to June 1, 1958).

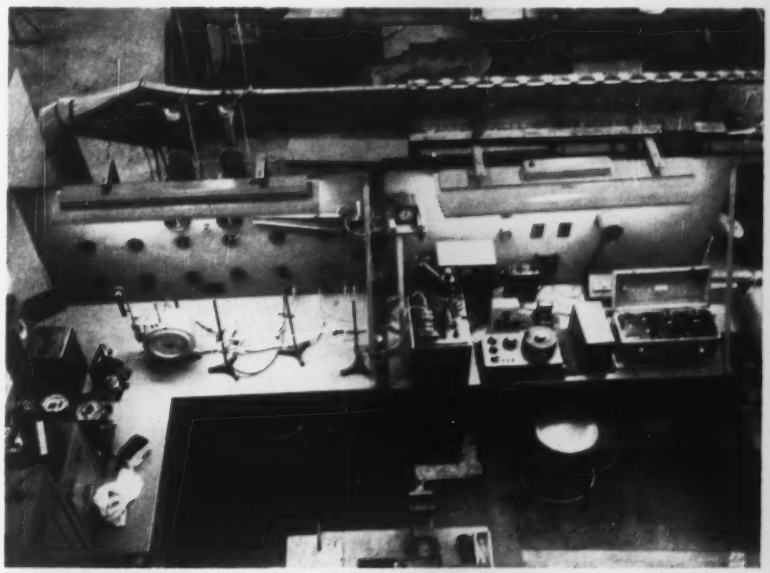
IN MANY industrial processes such as humidification, drying, mixing, and so on, turbulence exerts a marked influence on the transport of material or heat. In such processes the state of motion of the fluid, i.e., whether laminar or turbulent, is of primary importance. Furthermore, for design engineers, estimation of the basic sizes of equipment in these processes requires a knowledge of the resistance to mass or heat transfer. Approximately 30-60 per cent of the total resistance is generally contributed by the eddy diffusion in the turbulent core of the main flow.

THE role of eddy diffusion of mass (water vapor) and momentum was investigated in a specially devised wetted-wall channel in which the rippling of the liquid film was eliminated. The experimental measurements of the turbulent exchange coefficients for mass and momentum transport were carried out in a fully developed turbulent flow of air within the range of Reynolds numbers of 8000 to 160,000. A correlation with Reynolds numbers revealed an approximately linear relationship of the eddy diffusivities to Reynolds number. From the hotwire measurements it was found that within the main portion of the turbulent core eddy diffusivities remained fairly constant.

●

Radiant Heat Exchange in a Gas-Filled Enclosure, by H. C. Hottel, Mem. ASME, and E. S. Cohen, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-23** (multilithographed, available to June 1, 1958).

A METHOD is presented for predicting the effect of allowance for radiation exchange on the distribution of temperature and heat transfer within a furnace chamber. The system is divided into surface zones and gas zones—the number of zones dependent upon the desired accuracy of the result. Direct-exchange factors are available for gas-gas, gas-surface, and surface-surface zone interchange. A method is presented for determining, from these factors, the net exchange factor for any zone-pair, making due allowance for interaction with all other zones. The resultant factors are then fed into a set of energy balances, one on each zone, which by simultaneous solution permit a determination of the



Over-all view of experimental setup for investigation of the role of eddy diffusion of mass and momentum

space-distribution of gas and surface temperatures and the distribution of heat flux over the surfaces.

●

Heat Transfer Between Fluidized Solids Beds and Boundary Surfaces—Correlation of Data, by L. Wender and G. T. Cooper, Mem. ASME, The M. W. Kellogg Company, New York, N. Y. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-31** (multilithographed, available to June 1, 1958).

THE problem of determining heat-transfer coefficients between beds of fluidized solids and boundary surfaces (either the walls of the fluidizing vessel or tubes immersed in the bed) has attracted the attention of numerous investigators.

This paper presents a broad empirical study of nine independent sets of data on fluidized-bed heat transfer, with correlation of the data in two groups. A wide range of the many variables is covered, and some data on commercial units are included. The correlations indicate importance of heat transport by the mobile particle and of unsteady-state conduction in the gas.

●

Convective Heat Transfer From High-Temperature Air Inside a Tube, by H. E. Zellnik and S. W. Churchill, University of Michigan, Ann Arbor, Mich. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-33** (multilithographed, available to June 1, 1958).

LOCAL rates of convective heat transfer from air at high temperature to a cold wall were measured in the inlet region of a circular tube. Air entered the tube with a flat velocity and temperature profile at temperatures from 480 to 2000 F and flow rates corresponding to bulk Reynolds numbers from 4500 to 22,500. The inner surface of the 1.0-in-ID tube was maintained at approximately 100 F by water cooling. Local rates of heat transfer were determined at 1.5, 4, 7, and 10 tube diameters from the entrance by measuring the radial temperature profile in thermally isolated, annular sectors of the tube wall. The local rate data for all gas temperatures are well represented by previous correlations for small temperature differences if the gas properties are evaluated at the bulk temperature rather than the film temperature. The data agree well with the data of previous investigators wherever the experimental ranges overlap.

●

Heat Transfer in Thin-Film, Centrifugal Processing Units, by A. R. Gudheim, The Kontro Company, Inc., Petersham, Mass., and J. Donovan, Artisan Metal Products, Inc., Waltham, Mass. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-22** (multilithographed, available to June 1, 1958).

A CENTRIFUGAL thin-film unit, a new type of evaporator, distillation, or processing unit, has been developed, and is becoming more and more important for many specialized unit operations. The units perform many difficult operations continuously with materials hitherto difficult to handle.

Thin-film machines centrifugally spread the material to be processed over a heated or cooled wall in a comparatively thin film, maintained under turbulence with rotating, close fitting blades. The product flows through the unit by gravity, or by utilizing a portion of the centrifugal force generated.

Three basically different types of centrifugal thin-film units are currently available: Straight sided, vertical; reverse taper, horizontal or vertical; and forward taper, horizontal or vertical.

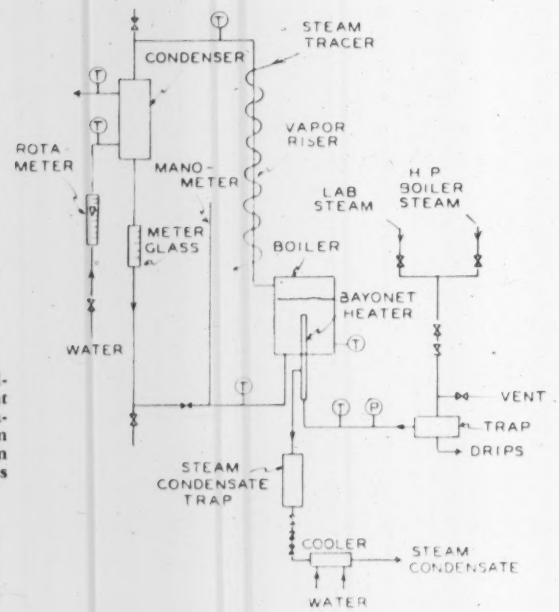
The object of this paper is to present heat-transfer information relating to these new centrifugal thin-film machines. Performance varies considerably with each machine, therefore, it is necessary to select the one best suited for a particular application.

●

Film Boiling From Vertical Tubes, by Y. Y. Hsu and J. W. Westwater, University of Illinois, Urbana, Ill. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-24** (multilithographed, available to June 1, 1958).

BROMLEY'S theoretical equations for heat transfer during film boiling have been shown to be reliable for horizontal tubes, but they have never been tested for vertical surfaces. High-speed photography indicates that the assumption of viscous flow for the vapor film is satisfactory for horizontal tubes, but not for vertical tubes. Heat-transfer measurements were made using vertical stainless steel bayonet tubes, $^3/_8$ and $^1/_2$ in. OD, with lengths from 2.6 to 5.4 in. The heat source was steam. The boiling film ΔT ranged from 154 to 314 F for three organic liquids and from 547 to 788 F for nitrogen, all at 1 atm. No forced convection was used. Benzene, carbon tetrachloride, and nitrogen on the longer tubes had h-values 2 or 3 times greater than predicted by the Bromley equation; however, the Reynolds numbers were found to exceed 2000. Nitrogen on the 2.6-in. length obeyed the equation; the Reynolds numbers were less than 2000. Methanol is an anomaly; although the Reynolds numbers were less than 2000, the flow was proved by photography to be turbulent and the h-values were much higher than predicted for viscous flow.

A correlation is given which fits all the data except for methanol. The correlation shows that a vertical orientation is superior to the horizontal for liquids boiling outside tubes.



Sketch of boiling equipment for investigation of film boiling from vertical tubes

Heat Transfer to Fluids With Low Prandtl Numbers for Flow Across Plates and Cylinders of Various Cross Sections, by R. J. Grosh, Assoc. Mem. ASME, Purdue University, Lafayette, Ind., and R. D. Cess, Westinghouse Research Laboratory, Pittsburgh, Pa. 1957 ASME Fall Meeting paper No. **57—F-29** (multilithographed; to be published in Trans. ASME; available to July 1, 1958).

LOCAL and over-all heat-transfer coefficients were determined analytically for one and two-dimensional flow of a fluid with small Prandtl number, such as a liquid metal, across a flat plate and cylinders of various cross sections. The possibility of heat generation within the fluid was considered. Certain of the results were simplified for convenient calculation and the approximations investigated. A comparison of the results with those of Pohlhausen and Squire showed good agreement. The procedure for obtaining these coefficients rested upon a consideration of forced convection in a fluid with small Prandtl number which implied that inviscid flow can be assumed and eddy transport of heat is negligible in comparison to molecular conduction for flows with small or moderate Peclet numbers. The analysis was simplified greatly by means of a transformation and certain results due to Boussinesq. The agreement of the analytical results with those obtained experimentally by Hoe for mercury flowing through tube banks and the method for calculating heat-transfer rates in tube banks will be described in a later paper.

●

Experimental Velocity and Temperature Profiles for Air in Turbulent Pipe Flow, by C. A. Sleicher, Jr., Shell Development Company, Emeryville, Calif. 1957 ASME-AIChE Heat Transfer Conference paper No. **57—HT-9** (in type; to be published in Trans. ASME; available to June 1, 1958).

IT IS often necessary to calculate the rate of heat transfer to fluids in situations for which no heat-transfer data exist. In many such cases, the rate of heat transfer can be calculated from known velocity distribution provided that the ratio of eddy diffusivity for heat to that for momentum is known. This paper describes an experiment in which the ratio was calculated from measured velocity and temperature profiles of air in fully developed flow in a pipe, at uniform wall temperature. The ratio was found to vary with Reynolds number and position, and in all cases was above the value of unity used by many authors. The ratio approached a constant of about 1.4 very near the pipe wall.

Total Normal Emissivity Measurements for Porous Materials Used for Mass-Transfer Cooling, by T. F. Irvine, Jr., J. P. Hartnett, Mem. ASME, and E. R. G. Eckert, Mem. ASME, University of Minnesota, Minneapolis, Minn. 1957 ASME Fall Meeting paper No. **57—F-8** (multilithographed; available to July 1, 1958).

WALLS fabricated of porous materials are utilized in various present-day engineering applications. An example of such use may be found on aircraft surfaces where certain areas of porous skin are included to reduce boundary thickness by suction and in this way to improve the lift or to maintain laminar boundary layers. Another important example involves the blowing of a coolant through a porous aircraft surface to provide protection of the surface from a hot gas stream. Such a cooling method is designated "transpiration cooling." By its application allowable temperatures probably can be maintained on the skin of high-speed aircraft and missiles, and on the walls of rocket nozzles and combustion chambers.

The temperature attained by such porous surfaces is determined primarily by a balance between the convective and radiative heat flow, and consequently the knowledge of the radiative properties of the porous materials is required for heat-transfer calculations.

It is the purpose of this paper to present total normal emissivity data for a number of such porous surfaces.

●

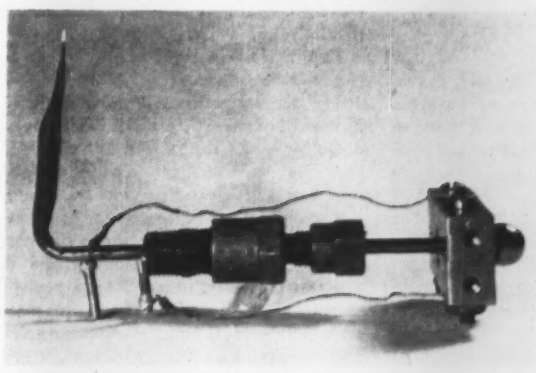
Thermal Conductivity of Insulating Materials for Use in Nuclear Reactors, by W. R. Morgan, Mem. ASME, General Electric Company, Evendale, Ohio, and W. G. Baxter, General Electric Company, Cincinnati, Ohio. 1957 ASME Fall Meeting paper No. **57—F-9** (multilithographed, available to July 1, 1958).

THE desirable properties of high-temperature insulating materials are well known. They should have low thermal conductivity, high resistance to dimensional deformation, high resistance to spalling, high resistance to abrasion, high resistance to chemical attack, and high strength at operating temperatures. When these materials are used in nuclear reactors two additional properties must be considered: namely, (*a*) there must be a minimum of nuclear poisoning by the chemical elements which make up the insulation and, (*b*), there should be no adverse effects on the thermal or mechanical properties when exposed to high order neutron and gamma fluxes.

A survey of the various insulating materials was made to find one which possessed all the properties mentioned and could operate satisfactorily in a nuclear reactor in the region of 1800 F with approximately 1400 F temperature drop across a 0.2-in. thickness of the insulation. Since a mineral-wool type material was considered most desirable, particular attention was directed to this type of insulation which is extensively used in the aircraft industry. Two materials appeared promising. These will be referred to as insulation A and insulation B.

Insulation A is an alumina-silica body and is available in felt form. Insulation B is essentially pure SiO_2 and was available at one time only in batt form. The literature indicated insulation A to have a small conductivity advantage at the temperature under consideration.

This paper presents the results of thermal-conductivity measurements of these two relatively high-temperature insulation materials both under nuclear radiation and in the absence of nuclear radiation. The apparatus employed for the measurements is described. Thermal-conductivity results are presented graphically and some conclusions pertaining to particle bombardment are given.



Velocity-temperature probe for experiments with velocity and temperature profiles for air in turbulent pipe flow

Applied Mechanics

Buckling of Rectangular Plates With Two Unsupported Edges, by P. Shuleshko, The New South Wales University of Technology, N. S. W., Australia. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-46** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

In this paper the elastic stability of rectangular plates compressed in two perpendicular directions by forces uniformly distributed along the edges is considered. Edges $x = 0$, and $x = a$ are simply supported, edges $y = \pm b/2$ are unsupported. The nondimensional coefficient $k = Pa^2/\pi^2 D$ for various ratios b/a and $\nu = P_1/P_2$ $(0 \leq \nu \leq \infty)$ is tabulated and corresponding graphs are presented.

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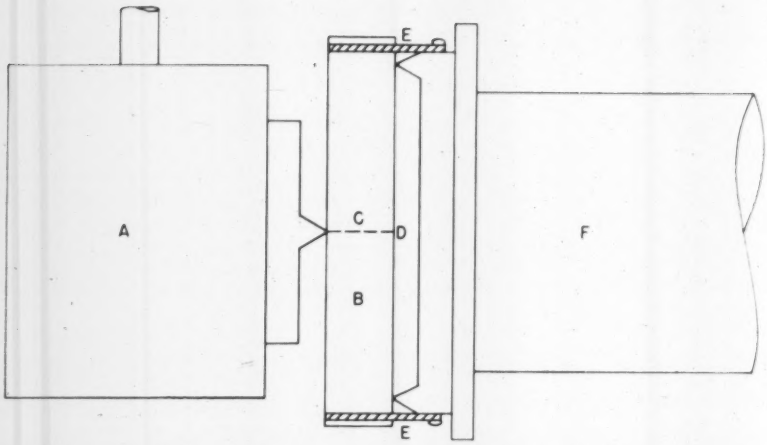
Thermal Drift of Floated Gyroscopes, by L. E. Goodman, Mem. ASME, and A. R. Robinson, Assoc. Mem. ASME, University of Minnesota, Minneapolis, Minn. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-31** (in type; to be published in the *Journal of Applied Mechanics;* available to April 1, 1958)

When a floated gyroscope is subjected to a temperature distribution which is not symmetrical about a plane parallel to the gravitational force, convection currents tend to rotate the gimbal. The rebalance torque and the free drift rate due to thermal effects are first determined for the case of an exactly centered gimbal. It is then shown that moderate gimbal eccentricity has little influence on thermal drift, and, in fact, reduces thermal rebalance torque.

•

A Photoelastic Study of Maximum Tensile Stresses in Simply Supported Short Beams Under Central Transverse Impact, by A. A. Betser, Ministry of Defense, Haifa, Israel, and M. M. Frocht, Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1957 ASME Applied Mechanics Summer Conference paper No. **57—APM-36** (in type, to be published in the *Journal of Applied Mechanics;* available to April 1, 1958).

Simply supported short Castolite beams of uniform rectangular cross section were subjected to central transverse impact by a heavy mass. Photoelastic streak photographs were taken of the transverse section of symmetry for a wide range of spans, widths, and impact velocities at exposures of less than 1 microsec. The maximum tensile stresses were determined. Comparison with the elementary theory for long beams shows that while this theory is satisfactory for long beams, it does not agree with the results from short beams. An approximate theory for short beams under central impact is developed which gives satisfactory agreement. The duration of impact also was determined and the appearance of isotropic points is discussed.



Simply supported beam under central impact: A, B, C, D, E, and F are hammer, Castolite beam, line of interest, point of interest, rubber bands, and anvil

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Tensor Flexibility Analysis of Closed-Loop Piping Systems, by J. W. Soule, United Engineers and Constructors, Inc., Philadelphia, Pa. 1957 ASME Fall Meeting paper No. **57—F-3** (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1958).

The author has developed in two previous papers a general procedure by means of which the basic tensor concepts and transformation formulas derived by Kron could be used for flexibility analysis of highly complex systems. Experience has shown that there are two troublesome complicating factors which frequently occur in applying either the tensor method or any of the various other methods of flexibility analysis:

1 Closed-loop systems, or systems which contain branches connected in parallel.

2 Branches inclined with respect to the co-ordinate axes.

The present paper will show in detail how each of these difficulties can be overcome by use of the proper techniques in applying the general tensor method which was developed previously.

A technique is presented for applying Kirchhoff's laws to the more complex structures, using the tensor method of analysis presented in previous papers by the author. Tensor formulas are used to solve a typical closed-loop piping system containing inclined branches.

Natural Frequencies of Nonuniform Beams on Multiple Elastic Supports, by R. A. Di Taranto, Assoc. Mem. ASME, Radio Corporation of America, Philadelphia, Pa. 1957 ASME Fall Meeting paper No. **57—F-5** (in type; to be published in the *Journal of Applied Mechanics;* available to July 1, 1958).

A method is presented for the determination of the natural frequencies of nonuniform beams on two or more torsionally and linearly elastic supports, including the effect of rotary mass moment of inertia. The method employed is an extension of the Myklestad method. The cases of two supports with varied end conditions and three supports with a torsional and linear restraint at each support are formulated. It is indicated how this method may be used for problems concerning forced vibrations of beams on multiple elastic supports and for the determination of critical rotor speeds including gyroscopic effects.

Availability List of Unpublished ASME Papers

A number of papers and reports were presented at ASME Meetings which were not preprinted or published. Manuscript copies of these papers are on file for reference purposes in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y. Photostatic copies of these unpublished papers may be secured from the Library at the rate of 40 cents per page to members; 45 cents per page to nonmembers. The following papers recently have been placed on file in the Engineering Societies Library:

1956 Annual Meeting

The Performance of the Demineralizer in the Preparation of High Quality Water, by I. B. Dick

1957 Spring Meeting

Mathematical Techniques of Incremental Loading, by H. W. Bomzer

Newest Techniques in Managing Maintenance, by O. Stewart

1957 Railroad Conference

Special Test Equipment on Railroads, by B. N. Seniff

Use of Economy Fuels in Diesel Locomotives, by P. V. Garin

1957 Semi-Annual Meeting

Friction and Wear Properties of Solid Film Lubricants, by R. E. Crump

Determination of Optimum Sizes and Economic Feasibility of Shipping Containers Using Operations Analysis Techniques, by J. D. Carrabino

Servo-Operated Panradiometer, An Engineering Need in Physiological Heat Transfer Studies, by A. M. Stoll, J. D. Hardy, and C. H. Richards

Problems in the Design of Cabin Doors for a Jet Transport, by C. Kerr, Jr.

Some Industrial Applications of Aluminum in an Aluminum Rolling Mill, by A. H. Koepf

Production Engineering Research and Its Practical Application in Great Britain, by D. F. Galloway

ASME Transactions

THE October, 1957, issue of the Transactions of the ASME (available at $1 per copy to members; $1.50 to nonmembers), contains the following technical papers:

Vibration Design Charts, by J. N. MacDuff and R. P. Felgar. (56—A-75)

Two Applications of a Digital Computer to Machine-Design Problems, by Joseph T. Lester, Jr. (56—A-98)

Application of Digital Computers to Bearing Design, by B. Sternlicht and F. J. Maginniss. (56—A-73)

The Effect of Condensate Reheat on Mean Temperature Difference in Feedwater Heater Subcooling Zones, by Karl A. Gardner. (56—A-69)

A Theoretical Analysis of Heat Transfer in Natural Convection and in Boiling, by Yan Po Chang. (56—A-42)

Heat Transfer to Lead-Bismuth in Turbulent Flow in an Annulus, by R. A. Seban and D. F. Casey. (56—A-62)

New Finite-Difference Technique for Solution of the Heat-Conduction Equation, Especially Near Surfaces With Convective Heat Transfer, by H. G. Elrod, Jr. (56—A-112)

Design of Supersonic Expansion Nozzles and Calculation of Isentropic Exponent for Chemically Reacting Gases, by R. Edse. (56—A-106)

Transient Air Temperatures in a Duct, by S. E. Rea and C. M. Ablow. (56—A-70)

Heat Transfer to Laminar Boundary Layers With Variable Free-Stream Velocity, by R. A. Seban. (56—A-125)

Experimental Studies of Free Convection Heat Transfer in a Vertical Tube With Uniform Wall Heat Flux, by J. P. Hartnett and W. E. Welsh. (56—A-113)

Heat-Transfer and Flow-Friction Characteristics of Woven-Screen and Crossed-Rod Matrixes, by L. S. Tong and A. L. London. (56—A-124)

Measurement and Integration of Acceleration in Inertial Navigation, by J. M. Slater. (56—A-160)

Pressure-Flow Characteristics of Pneumatic Valves, by F. D. Ezekiel and J. L. Shearer. (56—A-104)

Fork-Truck Stability—A Study in Moments, by R. W. Puder, W. H. Bogar, and R. D. Jay. (56—A-114)

Pressure Drop and Air-Flow Distribution in Gas-Turbine Combustors, by J. S. Grobman, R. T. Dittrich, and C. C. Graves. (56—A-208)

Nonhomogeneous Yielding of Steel Cylinder, 1—Mild Steel, by M. C. Steele and L. C. Eichberger. (56—A-39)

Delayed-Yield Time Effects in Mild Steel Under Oscillatory Axial Loads, by R. O. Belsheim. (56—A-108)

Apparent Frictional Forces on Clamping Elements as Used in the Oil Industry, by E. I. Moser and J. C. Wilhoit, Jr. (56—A-31)

An Investigation of Thermal-Stress Fatigue as Related to High-Temperature Piping Flexibility, by L. F. Coffin, Jr. (56—A-178)

Information Center With Automatic Logger and Scanner—Neches Power Station, Gulf States Utilities Company, by J. A. Reich and W. B. Gurney. (56—A-219)

A New Automatic Dispatching System at Kansas City, by D. H. Cameron and E. L. Mueller. (56—A-215)

Importance of Matching Steam Temperatures With Metal Temperatures During Starting of Large Steam Turbines, by R. L. Jackson, S. B. Coulter, and R. Sheppard. (56—A-177)

Instrumenting a Field Study of Industrial Water-Cooling Tower Performance, by J. L. Willa and Technical Sub-Committee No. 2 of the Cooling Tower Institute. (56—A-22)

Cooling Towers for Steam-Electric Stations—Selection and Performance Experiences, by M. W. Larinoff. (56—A-59)

Ultrafinishing—A New High-Precision Lapping Process, by T. G. Lewis, Jr. (56—A-77)

A Dynamic Performance Computer for Gas-Turbine Engines, by V. L. Larrowe, M. M. Spencer, and M. Tribus

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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Dual Powered, High-Speed Locomotive

Comment by D. S. Onnen[1]

The authors[2] have presented an interesting description of the salient features of the new dual-powered locomotive and should be congratulated for a job well done.

Although the paper is complete as it stands, a few added remarks concerning application and operation on the New York, New Haven and Hartford Railroad Company may be of interest.

In the embryo and application stages of the lightweight trains on the New Haven, it was determined that they should be equipped with one power unit at each end of the train. The paper describes one advantage of this arrangement double-ended control cabs. In addition, the schedule speeds which were to be maintained demanded the additional motive-power unit. The run between Boston and New York is plagued with many curves. Even at normal schedule speeds, ample power is required to provide proper acceleration from the numerous speed restrictions on curves.

In the interest of obtaining fast turn around time at Grand Central Terminal with the minimum of train servicing, a requirement was made that sufficient fuel should be carried to make the round trip, Boston-New York and return, without the necessity of refueling in Grand Central Terminal. This requirement was met by providing 725 gallons of fuel per locomotive. This is sufficient to make the round trip plus a $2^1/_2$-hour terminal layover. It should be remembered that this fuel supply must also take care of providing all train services, including electric heating and lighting. Even on the coldest days the fuel supply is ample with considerable margin for contingencies and delays.

The clearance problem on the New Haven lines and in the Grand Central Terminal area has been difficult to solve. The new truck design developed to provide greater stability at high speeds had precluded the use of a standard third rail shoe mechanism and beam assembly, since clearance requirements could not be met. This situation dictated journal box mounting of the shoe assembly. After leaving the third rail, on the New Haven, the shoes are always folded up to clear platforms, bridge structures, and so on. Even in the folded up position the shoe assemblies and shoes had to receive special design treatment to provide clearance on lines east of New Haven, Conn. Much serious study was given to the car-body contour, pilot, and truck appurtenances, to assure clearance through one of the most restricted "pikes" in the United States.

In the paper it was mentioned that when leaving the Grand Central Terminal area the power supply would be transferred from 600-volt third rail to diesel electric operation well in advance of reaching the end of the third rail at Woodlawn, N. Y. In actual operation of these locomotives we hope to transfer to diesel electric power in vicinity of 125th Street, New York. When this locomotive was originally developed we elected, in interest of simplicity, to keep the two traction motors connected in series only. By so doing, the locomotive is limited in speed when drawing power from the 600-volt third rail. Although near maximum permissible speed can be obtained with 300 volts per motor, scheduling requirements make it necessary to transfer to diesel in the vicinity of 125th Street.

The paper states that the 600-volt-d-c motor of the auxiliary motor-alternator set also does double duty as a 600-volt-d-c generator when it is operated in the diesel zone. This is an interesting application electrically, and one which certainly makes most efficient use of facilities at hand. Since the motor of this set would necessarily be turning over all the time in the diesel zone, it would have been necessary to circulate some current through the brushes to maintain commutator conditioning. It was developed that the conditioning current would be a pure power loss in itself, so why not condition the commutator with useful current? This was one of the many reasons for using 600-volt-d-c locomotive auxiliaries, thus "killing two birds with one stone."

We are anxious to get these locomotives into service to try the many new features incorporated. We look forward to low maintenance, versatile, smooth operating locomotives which will do justice to the new concept train they will haul.

[1] Chief engineer of equipment, The New York, New Haven and Hartford Railroad Company, New Haven, Conn. Mem. ASME.

[2] "Dual-Powered High-Speed Locomotive," by Robert Aldag and F. L. Sahlmann, MECHANICAL ENGINEERING, vol. 79, April, 1957, pp. 341–344.

Authors' Closure

One, it is somewhat misleading to state that the new truck design precluded the use of the standard third-rail shoe mechanism and beam assembly since clearance requirements could not be met. It is true that the new truck design precluded the use of the standard shoe and beam assembly, but for the reason that the outside mounted swing hanger and bolster springs prevented the standard application of third-rail shoes due to physical interference on the truck itself. This had no relationship to clearance of wayside structures as such.

Two, Mr. Onnen's comments were obviously written prior to April 1, which was the date on which these locomotives and the new train entered revenue service. It would now be interesting to have Mr. Onnen's comments as to the actual performance of this equipment during the past four and one-half months. We have the impression that this equipment is doing very well.

Robert Aldag.[3]
F. L. Salhmann.[4]

[3] Manager, Sales Engineering Department, Railroad Division, Fairbanks, Morse & Company, Chicago, Ill. Mem. ASME.

[4] Sales engineer, Locomotive and Car Equipment Department, General Electric Company, Erie, Pa.

Timber Construction

Comment by F. J. Wangaard[5]

THE author cites a number of convincing examples[6] of the slow-burning characteristics of timber construction, and of the opportunity thus afforded to minimize fire damage by allowing time to suppress combustion at its source. By simple calculation, the laminated timber shown as Fig. 9 in the paper retained 70 per cent of its original section modulus after exposure to an open fire for 1 hour.

This favorable aspect of timber construction is generally attributed to the low thermal conductivity of wood. The following table compares the thermal conductivity of wood with that of several other building materials. Specific heat and density values are also shown.

Material	Thermal conductivity, k*	Specific heat, c	Density, d, lb/cu ft	Diffusivity, h^2,† cu in/sec	Diffusivity ratio
Aluminum	1400	0.22	168	0.1255	570
Steel	310	0.12	486	0.0176	80
Concrete, sand, and gravel	12.6	0.25	137	0.00121	5.5
Brick	5.0	0.20	100	0.00084	3.8
Wood, air-dry, across grain					
Douglas fir	0.80	0.39	31	0.00022	1.0
White oak	1.20	0.39	45	0.00022	1.0

* Thermal conductivity (k) in Btu/sq ft/in/hr/F.

† In computing diffusivity (h^2) from the relationship $h^2 = \frac{k}{cd}$, values for conductivity were reduced to Btu/sq in/in/sec/F, and density to lb/cu in. For example, for Douglas fir, $k = \frac{0.80}{144 \times 3600} = 0.00000154$ and $d = \frac{31}{1728} = 0.0180$; $h^2 = \frac{0.00000154}{0.39 \times 0.0180} = 0.00022$ sq in/sec.

The rate of temperature change within a structural member heated by conduction from its surface is influenced by all three properties as expressed in the term *diffusivity*, $h^2 = \frac{k}{cd}$. The diffusivity of wood is substantially less than that of the other building materials listed. The diffusivity ratio given in the table indicates the relative rate of temperature rise in each material when exposed to the same conditions, thus aluminum heats 570 times as fast as wood and steel 80 times as fast.

Comment by Albert G. H. Dietz[7]

ENGINEERS often appear to be unduly influenced by the terms "combustible" and "incombustible" in their thinking with respect to materials, especially in construction. As fire engineers recognize, the terms may have little meaning in a building, especially, as is often the case, if the contents constitute a far greater fire hazard than the structure. The slow-burning characteristics of heavy timber, as exemplified by modern glued laminated structural members, are often much superior to light incombustible construction which is nevertheless destroyed by fire.

Mr. Hanrahan has presented the case for engineered timber by convincing argument. His points may well be heeded by engineers weighing the merits of various materials for a particular building project.

Author's Closure

We are indebted to both Professor Wangaard and Professor Dietz for their most helpful contributions.

By comparing certain properties of common construction materials, Professor Wangaard demonstrates some pertinent reasons why heavy timber construction has established such a remarkable fire safety record. This relatively slow spread of heat in wood, compared with other materials, tends to localize the fire damage in the case of wood. Dr. Wangaard's data, together with the known loss of strength of metals at elevated temperatures, explain why experienced firemen do not hesitate to enter the building or get on the roof of the building to fight fires when it is heavy timber construction; whereas, to protect the fireman's life from injury due to collapse, they normally will not do so in the case of a substantial fire in unprotected metal construction.

Professor Dietz, in calling attention to the facts that (1) heavy timber construction is often much superior to noncombustible construction, (2) that engineers appear unduly influenced by the terms "combustible" and "noncombustible" in selecting construction materials, and (3) that engineers should weigh the merits of the various materials for a particular building project, has pointed the way to not only better construction, but also to lower construction costs.

Frank J. Hanrahan.[8]

[5] Professor of lumbering, School of Forestry, Yale University, New Haven, Conn. Mem. ASME.

[6] "Fire Safety of Engineered Timber Construction," by Frank J. Hanrahan. Condensed from ASME Paper No. 56—A-137. MECHANICAL ENGINEERING, vol. 79, April 1957, pp. 350–352.

[7] Professor, civil engineering department, Massachusetts Institute of Technology, Cambridge, Mass. Mem. ASME.

[8] Executive vice-president, American Institute of Timber Construction, Washington, D. C. Mem. ASME.

Offshore Mobile Units

Comment by J. L. Goldman[9]

THIS is a relatively good time to have a general paper[10] presented on offshore mobile drilling units.

We can sympathize with the author's silent prayer for a test hurricane now rather than later. Beyond question these destructive Goliaths of Nature are going to roar into the Gulf. The surprising thing is that their unhappy visits have not been more frequent in recent years. However, we are not entirely without sign posts as to the effect of hurricanes upon mobile drilling units. During the summer of 1956, one of the smaller units our firm designed was set in approximately 22 ft of exposed water offshore. The vessel is new and was on its first offshore site. During a heavy storm of long duration, near-hurricane winds generated full breaking seas which bombarded the vessel for many hours. These waves were the maximum breaking waves that could have been generated in this depth of water. And, the depth of water in which the unit was working was right at its maximum rating. The vessel came through this test with no structural damage except to some minor fittings. The streamlined submerged hull did not move until the storm was half way over, but had some movement following the failure of the large drilling caisson. When the caisson was knocked over by the heavy seas, a large open hole was left in the slot area. As the soil from under the hull moved into this hole it set up a perfect condition for a sliding action to take place. It is reasonably considered that, had the caisson not failed, the vessel would not have moved under these

[9] Friede & Goldman, Inc., New Orleans, La.

[10] "Offshore Mobile Units—Present and Future," by Richard J. Howe and Bruce G. Collipp, MECHANICAL ENGINEERING, vol. 79, April, 1957, pp. 335–338.

hurricane-type conditions. But the main lesson such experiences teach us is that equipment as now being designed can and does have the ability and structure to withstand hurricane conditions.

Mobile drilling units are unique hybrid animals which are designed to live two contradictory lives. This Jekyll-and-Hyde existence stems from being first of all floating vessels and, at the will of the operator, become fixed islands sitting on a wide assortment of foundation materials. The problems of designing to suit each one of these sets of conditions alone are not small. In combination they represent what is possibly one of the most demanding engineering problems which has appeared to challenge the marine and petroleum industries.

Guiding Philosophy. Over the past ten years we have developed a guiding philosophy of a flexible nature to apply to mobile drilling units. The first guiding step is not to underestimate the strength of the enemy. While the maximum forces hurricanes can generate are not positively known, we prefer to design for maximum or near-maximum predicted conditions. A second point is to reject any thought of running away from a hurricane. The mobility of mobile drilling units falls far short of the agility required to escape hurricanes. They can only be moved in relatively fair weather. By the time we know a hurricane is headed to strike a mobile drilling unit, weather conditions at the drilling site may have reached a point where movement is impossible. Also the well conditions may make movement exceedingly undesirable, if not impossible. A third guiding post in designing mobile drilling units is known in military parlance as "presenting the smallest possible target." Obviously, if we have forces exerting a 1000 lb per sq ft loading, the total force is a product of this thousand pounds times the number of square feet. If we could have zero exposure we would have the happy circumstance of designing for zero *hurricane* loadings.

Design. This has led us to design column structures of minimum exposed area, which compared with other units frequently present one half and even one third the area to wave attack. We have pioneered the development and use of streamlined hulls, which when submerged are used to reduce wave loads and to reduce scouring action. Another point we keep strongly in mind is to achieve the towability of the unit when afloat. In fine weather we acknowledge that almost any kind of floating hull can be moved under reasonable control. In bad weather, units with poor towing hull forms quickly take charge of the tugs and rapidly become unmanageable. We hope it does not take a tragedy to point out the necessity of making the word "mobile" have more significance than simply to imply movability.

From the designer's vantage point a few comments on short-range development are in order. The basic types of units we will have to work with in the coming several years are probably in existence today, either in operation or under construction. While the appearance of a marvelous new tool that will make current designs obsolete is not an impossibility, the odds against it are exceedingly high. After all, we know the minimum needs which any new unit must fulfill. It must provide a reasonably sized platform deck above the breaking wave zone, which must be supported on a foundation of some sort to transmit loads to the ocean bottoms. This can only consist of a spread footing, pile foundation, pontoons, or perhaps a combination of them. The supporting structure between the foundation and the platform must obviously be streamlined and of minimum area, such as the tubular columns we use now.

The units of recent design usually fit the above description. Any differences to be expected in the near future will probably occur mainly in the mechanisms and details, and relatively few will deal with principles. Concerning units for various water depths, the general picture we expect appears as follows:

- In water under the 75-ft depth, the elevated-deck hull on-bottom unit has and should continue to have overwhelming popularity due to its relative simplicity and minimum first cost.
- In water over 75-ft depth and under 100-ft depth the double-hull-type unit or its near sister, supported on spuds, appears to be receiving widest acceptance.
- In water over 150-ft depth the floating drilling vessel seems at present like the best possibility.
- The possibility of perfecting ocean bottom completion methods will make mobile drilling units of all types even more attractive than they are at present.

The authors are to be complimented for presenting this timely and interesting paper. It is a good time for us to examine what we have done offshore and clarify our objectives for the future.

Are Engineers Professional?

Comment by V. Paschkis[11]

THE author in his paper[12] in the May, 1957, issue states that "the engineer has begun to emerge as a professional of great significance." While there is no question that the field of engineering has reached great significance, there is one major obstacle to the engineer becoming a professional comparable to physicians, lawyers, and ministers. These three professions are selected because some dictionaries give them as examples of professionals.

The obstacle in question is that of personal responsibility. While the majority of physicians and lawyers are "self-employed" the majority of engineers are employees. A physician or a lawyer would consider it contrary to his professional status to undertake work which he finds unacceptable from the point of view of its social or moral implications. He himself is the final judge of what to do with his skills and how to apply them. Engineers employed in industry or in business are normally not given such a choice. As long as such a choice is withheld, it does not seem appropriate to speak of engineers as professionals. Raising the question does not imply an answer. It is obvious that within the tightly knit organization as presented in industry or business it would be difficult to grant this kind of freedom; on the other hand, the writer believes that unless such freedom of choice is granted, engineering never will become a true profession. In view of the difficulty of this problem, it is hoped that either the ASME or EJC will provide for symposiums for a thorough exploration of this difficult problem.

[11] Director, Heat and Mass Flow Analyzer Laboratory, Columbia University, New York, N. Y. Mem. ASME

[12] "Developing Social Awareness in Engineers," by Sherwood B. Menkes, MECHANICAL ENGINEERING, May, 1957, vol. 79, pp. 457–458.

Author's Closure

One does not wish to reduce an honest argument to a discussion of semantics. Dr. Paschkis has chosen to comment on the basis of his interpretation of the word "professional." He feels that a necessary aspect of a "profession" includes a free choice not to undertake work which he finds unacceptable from the point of view of its social or moral implications.

I disagree, not on the grounds that a man should be forced into distasteful employment, but on the grounds that this in itself should not distinguish the professional. To me, a professional fills a social or an economic need, with a skill that is more mental than physical, and which requires some special education

or training to be developed. All free choices are of course criteria by which the democratic qualities of a society may be evaluated. But it is most impertinent to imply that a professional should have wider freedom to choose than a nonprofessional.

Furthermore, all of our economic activity is undertaken within the framework of our societal structure. Although the individual is afforded many choices in determining his career, there are many obvious possible restrictions on his range of choices. We do the best we can, and we try to do better. But it is grossly unfair to compare the restrictions on the range of choice between the professions of medicine, law, and engineering. There is nothing inherently immoral about any of them. It is perhaps unfortunate that engineering activity is intricately related to the business structure, and hence that much engineering activity is circumscribed by the rules of industry. The only immorality lies in the individual's appraisal of his own profession. Presumably Dr. Paschkis is disturbed by the high concentration of our engineering effort on the productions of weapons of a destructive nature. I cannot possibly argue with him as to his personal feelings in this connection. But I can hasten to point out that many other avenues of employment are open in the engineering field, to the extent that other economic needs must be filled. And I must also add that it is clearly the will of the majority of the people of the country, as evidenced by free elections, and by their representatives in the Congress, that such work is vital to our national security. To my mind the de-facto preservation of America takes precedence over all other political matters.

S. B. Menkes.[13]

[13] Assistant Professor of Mechanical Engineering, CCNY. Assoc. Mem. ASME.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Diesel Operation

DIESEL OPERATION AND FAULT DIAGNOSIS. By Gerald B. Fox. The Macmillan Company, New York, N. Y., 1956. Cloth, 6 × 9 in., indexes, figs., plate, 191 pp., $4.50.

Reviewed by E. J. Kates[1]

AMONG the many books on the subject of diesel operation, maintenance, and trouble-shooting this little book is unique; it not only tells the "how" but also explains the "why." Other books appeal mainly to the engine operator and the service mechanic; this one deserves a cordial welcome from engineers as well. Throughout the book, the author manifests his belief in "the value of finding the cause of a trouble and acting upon it, rather than of applying a palliative that is so often nothing more than an added nuisance." The latter practice, as every experienced engineer knows, is all too common.

Knowing that diesel operation itself is inherently simple, the author devotes little space to routine starting, running, and stopping procedures. Instead, he deals mostly with proper maintenance and intelligent trouble-shooting. In place of the usual dull tabulation of trouble symptoms and their immediate causes, the book is replete with interesting and instructive examples of how baffling difficulties were located and corrected. The title "Fault Diagnosis" is well chosen.

Naturally, to explain the "why," the author must deal with engine theory and design. This he does in simple and convincing fashion, showing keen perception of the problems involved. For example, in discussing the effectiveness of the drain holes for oil-control piston rings, he explains clearly why such holes should not be drilled *downwards* through the piston wall.

The author has spent some 40 years in the installation, testing, and development of diesel engines, and for many years was in charge of diesel testing and development at the British Admiralty Engineering Laboratory. Many engine designers can profit from the suggestions based on his wealth of experience in the practical handling of diesel engines of numerous kinds and sizes. For example, the author is not content with the mere statement that "the temperature of the top ring practically dictates the load that can be carried by an engine." He proceeds to describe laboratory experiments in which the temperature of the top ring was measured, and the influence of various factors was explored. Among these were varying speed at constant bmep; varying bmep at constant speed; exhaust back-pressure; temperature of cooling water; reducing the number of rings; reducing the distance from the top ring to the crown of the piston; restricting the air inlet to the engine; ambient air temperature; supercharging, and maximum cylinder pressure at various powers.

It should not be assumed from the foregoing that the author expects every user of this book to have elaborate modern instrumentation at his command. Although the book tells how to use such instrumentation when it is available, it also explains how to diagnose faults in its absence.

The book was written for Britons; it dealt only with British engines and it employs British terminology. However, the principles involved apply to all diesels, and the terminology will be clear to the intelligent American reader. But the latter will find nothing on dual-fuel or high-compression gas engines, with their detonation problems. Also lacking are discussions of vibration troubles and the cavitation-erosion of engine cylinders. There are a few minor typographical errors, and in some cases the several curves on a single chart are not identified.

The scope of this book is indicated by the chapter titles: Early Diesel-Engine Development, The Injection System; Instrumentation; Tuning the Diesel; Location of Faults, Pistons, Rings, and Liners; Bearings; Lubrication; Fuels; Combustion; Air Compressors and Superchargers; Starting Devices and Aids; The Logbook and Overhauls; Supercharging Methods; Various Designs Described.

The book is written in clear language, with a bright and lively style. It de-

[1] Consulting engineer, New York, N. Y. Assistant treasurer and Fellow ASME.

serves a place in the library of any engineer responsible for designing, operating, and maintaining diesel engines.

Books Received in Library

INTRODUCTION TO OPERATIONS RESEARCH. By C. W. Churchman and others. 1957, John Wiley & Sons, Inc., New York, N. Y. 645 p., $5^7/_8 \times 9^1/_4$ in., bound. $12. A general survey of this rapidly growing field is presented with particular reference to industry covering such subjects as inventory, waiting-time, allocation, and replacement models. The set-up of scientifically valid conditions for model testing, including the defining of properties and conditions of observation, and the checking of test results, is the subject of a later chapter. The concluding parts deal with the control and carrying out of the solution in actual practice, and with administration problems. Case histories illustrate each method and models, and chapter bibliographies provide for further reading.

MACHINE TOOLS FOR METAL CUTTING. By W. H. Armstrong. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. 347 p., $6 \times 9^1/_4$ in., bound. $5. This one-semester text for engineering students presents up-to-date material on machines, tools, and processes. Machine tools are defined and analyzed, and measurement methods and fits are discussed. The metal-cutting process is analyzed, and separate chapters are devoted to the general purpose machine tools for turning, boring, milling, grinding, and planing. Subsequent chapters cover broaching, ultrasonic and electrical-discharge machining, semi-automatic and automatic machinery, and a short discussion of automation.

MATHEMATICS AND COMPUTERS. By G. R. Stibitz and J. A. Larrivée. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. 228 p., $5^7/_8 \times 9^1/_4$ in., bound. $5. A general introduction to computation methods and devices, intended to give to the nonspecialist an understanding of basic concepts. Types of problems solved by computers, components and logical design of digital computers, analog computers and simulators, random numbers, numerical analysis, and applications are covered.

THE MECHANISM OF PHASE TRANSFORMATIONS IN METALS. (Institute of Metals Monograph and Report Series No. 18). Published 1956 by the Institute of Metals, London, England. 346 p., $5^1/_2 \times 8^3/_4$ in., bound. $7.50, Eighteen papers delivered at a symposium held in November, 1955. The papers are in two groups, one consisting of papers dealing with nucleation and growth processes, the other consisting of papers on martensitic transformations. Each group contains a general review paper followed by papers describing original research on specific problems: precipitation in lead-tin alloys; superlattice formation in the alloy CdM33; the allotropic transformation of cobalt; the bainite reaction in high-carbon steels; and so on. A subject index is provided.

MECHANISMS AND DYNAMICS OF MACHINERY. By H. H. Mabie and F. W. Ocvirk. 1957, John Wiley and Sons, Inc., New York, N. Y. 442 p., $6 \times 9^1/_4$ in., bound. $8.50. A two-part introductory text. Part one covers linkages, cams, gears, gear trains, and the elements of computing mechanisms and four-bar linkage. Part two covers kinematics of machinery, force analysis, balance, and vibration.

PASSIVIERENDE FILME UND DECKSCHICHTEN. Edited by H. Fischer, K. Hauffe, and W. Wiederholt. 1956, Springer-Verlag, Berlin, Germany. 400 p., $6^1/_4 \times 9^1/_4$ in., bound. DM 43.50. These 22 papers dealing with passive protective films and layers were presented at a German symposium on corrosion in 1955. Following a general treatment of scientific and industrial problems of metal oxidation and corrosion, sample topics are as follows: formation of oxide and tarnish films; the mechanism of the electrically passive film; phase boundary reactions; coatings formed during atmospheric corrosion; production of synthetic films; chemical polishing phenomena; porous layers, radioactive study, and the like.

PATENT NOTES FOR ENGINEERS. By C. D. Tuska. Seventh Edition, 1956. McGraw-Hill Book Company, Inc., New York, N. Y. 192 p., $6 \times 9^1/_4$ in., bound. $4. This is a discussion of the practical problems that arise from the moment of conception of a patentable invention to the acquiring of patent rights. Illustrated by numerous cases and examples, the discussion covers invention as defined in patent law; the need for good records and adequate disclosures; the preparation and prosecution of applications; and the ownership and use of patents.

PRINCIPLES OF ENGINEERING HEAT TRANSFER. By Warren H. Giedt. 1957, D. Van Nostrand Company, Inc., Princeton, N. J. 372 p., $6 \times 9^3/_8$ in., bound. $8.25. A text for third-year students, covering energy transfer, fluid flow, conduction, convection, and radiation. The book has been designed to meet the needs of electrical and industrial as well as mechanical-engineering students.

PRINCIPLES OF TRANSPORTATION. By Frank H. Mossman and Newton Morton. 1957, Ronald Press Company, New York, N. Y. 510 p., $6 \times 9^1/_4$ in., bound. $6.50. This text deals with the economics of transportation; rate making; government controls; carrier operation and management; national transportation policy; and the historical growth and the regulation of each major type of transport (including pipelines and urban systems). Piggy-back operations are discussed in one chapter of a section devoted to selected carrier problems.

PRODUCTION FORECASTING, PLANNING, AND CONTROL. By E. H. MacNiece. Second Edition, 1957. John Wiley & Sons, Inc., New York, N. Y. 374 p., $5^3/_4 \times 9^1/_4$ in., bound. $8.25. The engineering principles of production management are emphasized in this book, with effective applications of these principles and their economic and social implications. Some new features are chapters on automation, specialization, standardization and simplification, level production and its relation to the guaranteed annual wage, and a report on production-engineering education and practices in Europe. A bibliography lists general references for each chapter.

QUALITY CONTROL FOR PLASTICS ENGINEERS. Edited by L. M. Debing. 1957, Reinhold Publishing Corporation, New York, N. Y. 142 p., $6 \times 9^1/_4$ in., bound. $4.95. Intended to provide a practical guide to an effective working program of quality control in plastics plants, this book describes such methods as frequency distribution for quality analysis, control charts for variables and for attributes, specifications, sampling by inspection, and process capability analysis. The separate chapters are by members of the Society of Plastics Engineers and are reprinted, in part, from the SPE Journal.

STAHLDRAHTERZEUGNISSE. Issued by the Ausschuss für Drahtverarbeitung, Verein Deutscher Eisenhüttenluete. 1956, Verlag Stahleisen, Düsseldorf, Germany. 2 volumes, $6^3/_8 \times 9^1/_4$ in., bound. DM 70.00. The material contained in this reference work on steel-wire products consists of separate articles on manufacture and use of a wide range of products: wire rope; welding rods; wires and wire mesh for concrete reinforcement; coil springs; steel balls and rollers; needles, chains, rivets; wire nails and other wire hardware; various automotive accessories. A considerable amount of technical data, metallurgical and otherwise, is included.

STUDIES IN ANCIENT TECHNOLOGY. Vol. 4. By R. J. Forbes. 1956, E. J. Brill, Leiden, Netherlands. Available in the U.S. from W. S. Heinman, New York, N. Y. 257 p., $6^1/_4 \times 9^3/_4$ in., bound. $6.50. Continuing the series, this concise book concentrates on the history of textile fibers, and the processes and tools used in their preparation. The fibers and fabrics of antiquity, and the processes of washing, bleaching, fulling and felting, dyes and dying, spinning, sewing, basketry and weaving are each dealt with. An extensive bibliography at the end of each chapter refers the reader to original source material as well as essays by experts.

THERMODYNAMIC TABLES AND OTHER DATA. Edited by R. W. Haywood. 1956, Cambridge University Press, New York, N. Y. 23 p., $6^1/_8 \times 9^3/_4$ in., paper, 50 cents. Condensed tables of thermodynamic data for practical use, extracted and calculated from various authoritative sources. Section 1, steam tables, gives data on superheated steam, saturated water and steam, and compressed liquid water. Section 2, on refrigerants, gives data on ammonia, carbon dioxide, Freon-12, and methyl chloride.

TOOL DESIGN. By C. Donaldson and G. H. LeCain. Second Edition, 1957. McGraw-Hill Book Company, Inc., New York, N. Y. 557 p., $6 \times 9^1/_4$ in., bound. $6.75. A text covering general methods for the design of cutting tools, punches and dies, gages, jigs and fixtures, and cams. Relevant aspects of springs, welding, and tolerances are also dealt with, and two chapters are devoted to the automatic screw machine.

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Roundup

Of Current Engineering Events, News, and Comment

E. S. Newman, *News Editor*

What Effect Have Recent Inventions and Discoveries Had on Engineering Curriculums and Education?

Deans of engineering meet at Purdue to review education status to find answers

A FOUR-DAY conference on science and technology for deans of accredited engineering schools was held September 9–11 at Purdue University.

With the growing impact each year of new inventions and discoveries the demands for strengthening engineering and scientific curriculums become ever more stentorian. The aim of this conference was to find "precisely what are those legitimate demands and how may they be met?"

The conferees numbered 61 deans from 26 states. Five more engineering colleges were represented among the 16 speakers who addressed the conference designed to give engineering administrators an opportunity to review recent developments in seven major fields of engineering and science, and to consider the effect of these new developments on engineering education.

Seven Fields of Engineering Covered

The subjects covered included: Computer development and applications; automation and automatic control; system analysis and operations research; thermodynamics; mass, momentum, and heat transfer; nuclear engineering; and solid-state physics and engineering materials. A session was devoted to discussion of the trends in cost of engineering education. Lively discussions by the deans followed the addresses on each subject.

It was estimated that the gathering, including speakers and conferees, represented institutions responsible for over 50 per cent of undergraduate instruction in engineering and 75 per cent of instruction at the graduate level.

Five of the 61 deans of engineering attending the Purdue conference on engineering and technology, September 9–11, span the country. ***Left to right:*** **W. T. Alexander, Mem. ASME, Northeastern University, Boston, Mass.; G. A. Marston, University of Massachusetts, Amherst, Mass.; G. T. Harness, University of Southern California, Los Angeles, Calif.; S. H. Byrne, Virginia Polytechnic Institute, Blackburg, Va.; and Glenn Murphy, Mem. ASME, Iowa State College, Ames, Iowa.**

Centers of Learning

Typical of many observations made by speakers was that of Gordon S. Brown of M.I.T. who suggested that universities create "centers of learning" in four general areas, namely: communication, energy exploitation, engineering materials, and mobility and transportation —cutting across conventional engineering departments. In similar vein, J. P. Nash of Lockheed Aircraft Corporation, speaking of the impact of computer development upon engineering education, said that the increased use of computers affords opportunity to enrich the engineering curriculum with more of basic understandings. Along the same line, Myron Tribus, Mem. ASME, UCLA, who with Newman A. Hall, Mem. ASME, Yale University, covered the field of thermodynamics, expressed a belief in the desirability of breaking through the boundaries between the divisions in engineering. He said, "Concepts and principles of general utility will enable the engineer to meet the problems of an increasingly complex world."

F. L. Hovde, president of Purdue University, speaking to the group on administrative problems under pressure of increasing enrollment, emphasized a compelling necessity to minimize specialized engineering curriculums.

Computers in 1965

Samuel Alexander of the Bureau of Standards spoke of the possibility of a

billion-dollar annual sale of computers by 1965 with corresponding pressure on universities for skills in design and manufacture. J. G. Truxal of the Polytechnic Institute of Brooklyn, formerly a member of the Purdue faculty, discussed automation. He said that the marriage of computers and control systems was the most significant recent development—visualized ten years hence a digital computer with a control system on a military plane to control all essential functions of the plane including firing and navigation, and added that any student of automatic control is likely to wind up on a military project.

Other Appraisals

E. R. G. Eckert, Mem. ASME, University of Minnesota, and R. B. Bird, University of Wisconsin, surveying the field of mass, momentum, and heat transfer, held that undergraduate training in physics on the subjects of momentum transfer, energy transfer, and mass transfer is inadequate, and that unnecessary duplication exists in various engineering departments, and recommended treating transport processes as a unified subject covering principles that are applicable to all fields of engineering.

J. E. Goldman of the Ford Motor Company and Glenn Murphy, Mem. ASME, of Iowa State College, speaking on solid-state physics and engineering materials, stressed the need for more engineers having the basic training that has in the recent past been in the realm of solid-state physics rather than in any branch of engineering. Dr. Murphy said, "All the products of an engineer's activities are expressed in terms of materials. Within a few years no engineering graduate can hope to practice his profession in other than a subordinate capacity without knowledge of the science of materials."

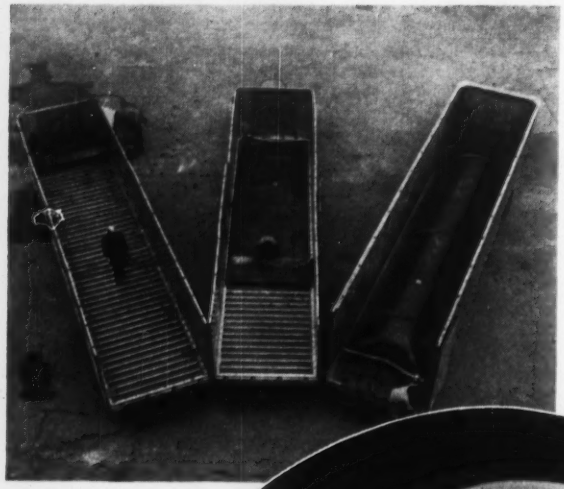
G. A. Hawkins Sums up

George A. Hawkins, Fellow ASME, dean of the Purdue University Schools of Engineering, who was host of the conference, was quoted as saying at the end of the conference that from the comments of the group, he would conclude that major problems of the future may be two-fold; first, the integration of subject matter and, secondly, the development of a dual engineering program—one for those interested in the functions of research, design, development, and education, and one for those interested in construction, maintenance, estimation, production, and sales—the former highly oriented toward mathematics and the physical sciences, and the latter with a strong foundation in mathematics and physical sciences, but oriented toward the humanities. He emphasized that both are equally important and hold the same level in society.

Dr. Hawkins said that the idea of the meeting grew out of discussions in recent months with many of his colleagues in engineering administration.

The proceedings of the conference which was financed by Purdue University and the Purdue Research Foundation will be published in book form.

Engineering Research Building. Engineering development building at U. S. Rubber's new Research Center in Wayne, N. J., is headquarters for company's research work in process and product evaluation. Scientists here determine how useful rubber or plastic compounds might be and what type of products can be made from these compounds. U. S. Rubber plans to spend a minimum of $120 million on research and development over the next five years.



Two-Way Haul. Three basic steps convert a trailer truck for dry-liquid two-way haul—dry cargo in one direction to liquid cargo in the same trailer on its return trip. Sealdtank in truck, *left,* is rolled into compact cylindrical package only 25 in. in diam. After removal of dry cargo it is unrolled, *center,* and filled with as much as 20 tons of liquid for return trip, *right.* Sealdtank is a giant rubber-fabric container developed for rail, truck, and barge industries.

Tires of the Future. Seen through a low-profile tire, which is expected to be standard equipment on all 1959 cars, are three experimental tires developed by U. S. Rubber. At *left* is an improved butyl rubber tire for better riding qualities. *Center* tire is made of Vibrathane, a polyurethane rubber. It gives 200 per cent more mileage than present tires. At *right* is a silicone and wire tire for aircraft use at supersonic speeds. It withstands temperatures up to 500 F.

Meetings of Other Societies

Nov. 14–16

The American Society of Refrigerating Engineers, semi-annual meeting, Shoreland Hotel, Chicago, Ill.

Nov. 18–21

Air-Conditioning and Refrigeration Exposition, International Amphitheatre, Chicago, Ill.

Nov 21–22

American Management Association, organizing a new product program, Statler Hotel, New York, N. Y.

Dec 2–6

26th Exposition of Chemical Industries, Coliseum, New York, N. Y.

Dec. 2–7

International Standardization Organization, meeting of technical committee 44 on welding, Paris, France.

Dec. 3–4

Institute of Radio Engineers and Human Factors Society of America, joint symposium on human factors in systems engineering, Penn-Sherwood Hotel, Philadelphia, Pa.

Dec. 4–5

Armour Research Foundation, national construction industries conference, Hotel Sherman, Chicago, Ill.

Dec. 5–6

Illinois Institute of Technology, industrial engineering conference, Illinois Institute of Technology campus, Chicago, Ill.

Dec. 8–11

American Institute of Chemical Engineers, annual meeting, Conrad Hilton Hotel, Chicago, Ill.

Dec. 9–12

Eastern Joint Computer Conference and Exhibit, Sheraton-Park Hotel, Washington, D. C.

Dec. 15–18

American Society of Agricultural Engineers, winter meeting, Edgewater Beach Hotel, Chicago, Ill.

Dec. 17

Institute of Aeronautical Sciences, Wright Brothers Lecture, Department of Commerce Auditorium, Washington, D. C.

(*ASME Coming Events—see page 1100*)

Coming Meetings

Rockets

A FIRST intercollegiate student conference on rockets and their related sciences is in the planning stage as a feature of the International Geophysical Year.

Under the auspices of the Polytechnic Institute of Brooklyn Student Chapter, the American Rocket Society will hold a two-day Eastern Regional Student Conference at the Statler Hotel, New York, N. Y., December 6 and 7.

Graduate and undergraduate students enrolled in science and engineering courses in the colleges are being invited to submit papers for presentation. Suggested subjects are: Rockets, guidance, propulsion, astrophysics, and other topics related to the IGY program.

Students submitting papers will be considered as candidates for the new ARS Chrysler Corporation Student Award of $1000.

U. S. Rubber Opens New Research Center

Electron Accelerator. Two million volt Van de Graaff electron accelerator installed in the Center will enable the company to learn more about the effects of atomic energy on its products. It will also speed the development of new rubbers and plastics. Shown are calcite crystals which have just been bombarded by two-million volt electrons. Calcite crystals are normally transparent like glass but when subjected to high voltage, give off an eerie orange glow.

Man-Made Weather. This instrument, called a Weatherometer, creates both sunshine and rain at new Research Center in order to test how well various rubber compounds used in tires, footwear, and industrial products will stand up against the effects of outdoor use. A carbon arc in center of the instrument creates the sunshine and rubber samples revolve around it for 40 min. A fine spray of water covers the samples for the last 20 min of this weather cycle.

Photographing Drop of Soap. Soap solution is an important ingredient of liquid rubbers (rubber latex compounds). This equipment is used to photograph one drop of soap solution. By measuring the size and shape of the drop on a negative, it can be found whether or not a particular soap solution will produce a high-quality rubber latex compound. Hypodermic needle contains soap solution which is injected into compartment in front of camera.

U. S. Must Meet USSR Challenge to Maintain Strength, Progress

Dean Dunning gives "cold" facts at Combined Plan College Conference

THE United States must meet the challenge of the Soviet Union in an "age of technological imperialism" if our strength and progress are to be maintained, John R. Dunning, Mem. ASME, dean of the Columbia University School of Engineering, warned.

"While the Soviets have already begun their exploitation of this new and awesome age," Dr. Dunning stated, "we have not, because our people, our government, and our schools have not yet grasped its full significance."

In his statement, made at the close of the Combined Plan College Conference, October 6–9, at Columbia's Arden House, Harriman, N. Y., Dean Dunning noted that this country must find ways "to divert more of our national income and effort" toward the problems of technology and technological education in order to counter the threat of a "vastly more powerful Russia."

Dean Dunning, a pioneer atomic physicist, addressed an audience of presidents, deans, and other representatives from 42 colleges and universities participating in Columbia's combined undergraduate engineering program. The conference, sponsored by the School of Engineering, discussed humanistic aspects and problems of "Learning in a Materialistic Culture."

The Columbia dean's statement follows: "In this age of intercontinental missiles and earth satellites, it has become impossible for our colleges and universities to remain complacent about the need for and the education of scientists and engineers. Indeed, it is a strange thing for our nation to have been complacent about the matter for so long.

"We cannot afford to be so any longer. We have a struggle ahead of us which has become much closer and more crucial than we thought it would ever be. It is the struggle of technological development, and where once we had the superior strength, that is simply not so today. For in truth, despite our feelings on communist ideology and in spite of our hope and belief that its power is on the wane, the technology of the USSR has been gradually but very consistently catching up with our own—and in some areas at least, has passed us by. In the period of only a few short years, and although we have seen it and known it to be coming, the progress of Soviet science and the development of Soviet scientists have come to the point where they can be said to be surpassing our own efforts."

Age of "Technological Imperialism"

"We have entered the age of technological imperialism. And while the Soviets have already begun their exploitation of it, we have not, because our people, our government, and our schools have not yet grasped its full significance.

"It is the challenge of the technological which the Soviets have thrown out to us. It is the threat of a vastly more powerful Russia, and at the moment, the advantage is theirs. With the power to divert the complex of national economy in any desired direction, the USSR has promoted its technology virtually without limits. With the power to channel human efforts along those paths best serving the communist system, that system has been able to produce scientists and engineers in certainly greater numbers and quite possibly of higher technical proficiency than our own.

"Even this last possibility is not surprising when one considers that the USSR has concentrated almost entirely on intensive technical training at the expense of the wider intellectual breadth we have tried to form in our own scientists and engineers.

"We have seen for some time that the Russians would outnumber us in sheer quantity of technological personnel. As a result we have advocated, and rightly so, increased attention to the quality and kind of thinking of our personnel. In this country, in our sciences, creativity and scholarship are not separate endeavors; the progress of science and engineering in America is not at the expense of the liberal arts, but goes along hand in hand with them. This is what has been the saving grace of American technology; in the long run it will enable us to win any contest of either force or progress."

Soviets Are Challenging Us

"Now, however, it has come to the point where the right spirit alone is not enough. The Soviets are challenging us, and a drastically new outlook is going to be necessary to answer that challenge. Thus far, we have been able to maintain technological supremacy without undue stress or strain on our way of life. Whether this will remain so much longer has become a vital question, and indeed, whether we have done too little too late to answer the bid for technological imperialism on the part of the USSR may become another.

"The most important question, however, is the problem of answering the Soviets on their own terms: of how to divert more of our own national income and effort towards science and engineering and their teaching—without sacrificing human values or the liberal way of thinking, and without lowering that standard of living we have enjoyed so long. That this is still possible is no longer the certainty it once was. It begins to look as though our people might yet have to choose between the luxury of new automobile models each year and the kind of technology which will maintain our economic status and insure continued progress in this country."

U. S. Must Answer—All Together

"More than ever before, the development of the sciences, and the encouragement and education of potential engineers and mathematicians—and the teachers to train them—require the support of our entire society.

"We need the co-operation of the mass media to convince the nation of the necessity for such development and encouragement; we need the willingness of our schools to take a stern look at their curricula; and we need the assistance of both industrial and government aid to make both of these practical realities.

"It is only with this support that we will regain the edge in technology. And it is only if we are successful in countering this 'new imperialism' that the effort of free men in a free society, along lines of both technique and spirit, will capture the mind and imagination of man the world over."

The combined plan is the Columbia Engineering program through which students begin their higher education with three years of liberal arts studies at their individual colleges and follow up this training with engineering studies at Columbia. Upon graduation in their fifth year, they receive both AB and BS degrees.

The concept on which the combined plan is based is that "the best way to train an engineer is to educate a man." The combined plan, which started at Columbia in 1951 with a single mechanical-engineering student from Baldwin-Wallace College, now accounts for nearly 20 per cent of the undergraduate engineering students at Columbia.

ASME News

With Notes on Society Activities and Events

E. S. Newman, *News Editor*

1957 ASME Annual Meeting, in New York, Will Be Pace-Setting Event—December 1-6

Program lines up innovations, more technical sessions, inspection trips, social events, a women's program, and general meetings of note

THE enormous effort required to present the Annual Meeting of The American Society of Mechanical Engineers is being exerted in monumental proportions to make the 1957 meeting the most significant of those in a long list of previous years.

From December 1 through 6 thousands of ASME members and their guests will be headquartered at the Statler and McAlpin Hotels in New York, N. Y., to participate in more than 140 technical sessions, wherein will be presented the outstanding papers of the year. In addition to the customary fields of engineering to be covered, there will be a "Creep Design Workshop"—an innovation this year. The Business Meeting of the Society, which all members are urged to attend, will include a report on the new United Engineering Center. The Council of ASME, carrying on a practice of the past year, will open its sessions on Saturday, November 30, at 1:00 p.m. and members are invited to attend.

In the program, as published in the October issue of MECHANICAL ENGINEERING on pages 987–995, one readily realizes the scope of the plans for the meeting. The following last-minute information is given to our readers to help them in arranging their individual schedules to derive the maximum benefit and enjoyment during the meeting.

Creep Design Workshop

The Metals Engineering Division has planned an audience-participation program in three parts for Friday morning and afternoon at the Annual Meeting. The subject is Creep Design, that is, the design of machine parts and structures in which creep or creep-rupture is encountered.

A panel of speakers has been assembled to introduce the subjects for discussion. Each is a prominent authority on the topic he will introduce. With audience participation the design engineer will be able to exchange viewpoints with those interested in theoretical or applied mechanics, metallurgy, and physical properties.

The speakers and subjects to be discussed are as follows:

Putting the final touches to George Westinghouse's head with a modeling tool, the sculptor Edmondo Quattrocchi prepares to cast the bust in bronze. On the table in foreground are three preliminary models. The bust is purposefully turned to the wall. No photographs of the Hall of Fame occupants are permitted until the actual unveiling ceremonies on Dec. 1, 1957.

Morning Session

1 Creep-Rupture Data—Testing and Interpretation

(*a*) Uniaxial stress at constant temperature: 1 Creep, 2 Rupture.
By Prof. N. J. Grant, M.I.T.

(*b*) Cyclic stress and temperature: 1 High frequency, 2 Low frequency.
By Prof. B. J. Lazan, U of Minnesota, and Dr. L. F. Coffin, Knolls Research Lab., Schenectady, N. Y.

(*c*) Combined stress
By L. F. Kooistra, The Babcock and Wilcox Co.

2 Creep Design:

(*a*) Theories of creep
(*b*) Stress analysis
(*c*) Failure criteria
(*d*) Ductility requirements
(*e*) Factors of safety
By Dean C. R. Soderberg, M.I.T.; S. S. Manson, NACA, Lewis Flight Propulsion Lab., Cleveland, Ohio, and Prof. N. J. Hoff, Stanford U, Palo Alto, Calif.

Afternoon Session

3 Service Life

(*a*) Simulated service tests, comparison with laboratory tests
C. C. Bigelow, Pratt and Whitney, Middletown, Conn.

(*b*) Residual life of a structure after a given service
W. E. Trumpler, Jr., Westinghouse, Philadelphia, Pa.

(*c*) Correlation of service experience with design practice
A. W. Rankin, General Electric, Schenectady, N. Y.

Since the success of such a workshop depends on the exchange of ideas and information between the panel and audience, those who are interested in the subject of creep design are urged to attend.

The chairman and vice-chairman of the sessions are Prof. M. E. Shank of Massachusetts Institute of Technology and M. J. Manjoine of the Westinghouse Research Laboratories, Pittsburgh, Pa.

Hall of Fame Ceremony

A bust of George Westinghouse, President of ASME, in 1914, engineer and inventor, and one of Willard Gibb, scientist, will be unveiled at the Hall of Fame for Great Americans of New York University, on the University Heights Campus, 181st St. and University Ave., on Sunday, Dec. 1, 1957, at 3:00 p.m.

Former President Herbert Hoover and Detlev W. Bronk, Honorary Members of ASME, will speak at the ceremony.

New United Engineering Center

. . . to be discussed at Business Meeting

The annual business meeting of the members of The American Society of Mechanical Engineers will be held on Monday afternoon, Dec. 2, 1957, at 4:45 p.m. at the Hotel Statler, New York, N. Y., as a part of the Annual Meeting of the Society.

In addition to the usual business, there will be a presentation of the Society's annual report to the members and a special report by the ASME representatives on the United Engineering Trustees on the new United Engineering Center being planned for a site near the United Nations in New York.

Members are urged to attend.

Members and student members of engineering and scientific societies are welcome to attend. Invitations may be obtained by applying to the Hall of Fame, 53 Washington Square South, New York 12, N. Y., before Nov. 15, 1957.

Inspection Trips

Tuesday, December 3. Long Island Lighting Company, Barret Plant, Island Park, N. Y. First outdoor power-distribution plant in this part of the country will be shown. The tour will include the opportunity to observe the Hicksville engineering center, underground distribution center, emergency-control room, maintenance, and service facilities.

Tuesday, December 3. Esso Research and Engineering Center, Linden, N. J. Tour takes in visits to engine and test-car, Enjay rubber and wax laboratories. Oils, grease, and other petroleum products are developed and tested at the Esso Research Center. Enjay is developing and testing natural and synthetic rubbers. Trip will be limited to 50 persons.

Thursday, December 5. Bell Telephone Laboratories, Murray Hill, N. J. The visit will cover the mechanical-engineering research and development problems and design as required for communication operations of the Bell System. Specific points of interest will be the Outside Plant mechanical developments and mechanical design applied to ultra-high-frequency components.

Thursday, December 5. Fort Toten and Fort Tilden – Medical Equipment-Laboratory and Nike Base. Laboratory develops and designs medical equipment for the Army, Navy, and Air Force. Equipment must be lightweight, strong, and easy to operate in the field. "Jet Gun" for immunization without needles, sterilization, or pain was developed here.

Operational Nike Base is attached to 1st Region Army Air Defense Command. Explanation of operation and safeguard will be followed by tour of Nike site.

College Reunions

University of California: The Alumni of the University of California will hold a reunion luncheon at 12:15 p.m., Thursday, December 5, at Toots Shor Restaurant. The speaker will be Armand G. Erpf, manager of the investment department of Carl M. Loeb, Rhoades & Company. Please make reservations through Col. Francis I. Maslin, secretary-treasurer of the University of California Club of New York, 37 King Street, New York, N. Y.; by phone, Chelsea 2-2477.

Carnegie Institute of Technology: Reunion Luncheon, Thursday, December 5, at 12:15 p.m., at the Architectural League of New York. The speaker will be Russell H. Bintzer, vice-president of Carnegie Tech. Call or write Murray Lieblish, 36 West 66th Street, New York 23, N. Y.; phone, Trafalgar 7-2050.

The Cooper Union: Mechanical-Engineering Reunion at The Cooper Union, Thursday evening, December 5, in room 6H of the Hewitt Building. The laboratories will be open for inspection between 5:30 and 6:30 p.m. All who are planning to attend are urged to call Prof. William A. Vopat as early in the week as possible at Algonquin 4-6300, Ext. 19.

Georgia Institute of Technology: The fall dinner meeting of the Georgia Tech Club of New York will be held at 6:00 p.m., Thursday, December 5, at Reeves Sound Studios. Edwin D. Harrison, president, Georgia Tech, will be the guest speaker. Call or write Herbert W. Dieckmann, Universal Atlas Cement Company, 100 Park Avenue, New York 17, N. Y.; phone, Murray Hill 6-7400.

Iowa State College: The New York-Iowa State Alumni Association will hold a cocktail party at 5:00 p.m., Thursday, December 5. Write or call John G. Lutz, Pneumatic & Electric Tool Division, Ingersoll-Rand Company, 11 Broadway, New York, N. Y., phone, Digby 4-6070.

Michigan State University: Engineering Alumni will meet on Thursday evening, December 5. Write M. C. Lewis, 33 Fremont Road, North Tarrytown, N. Y.

University of North Dakota: Reunion Luncheon, Thursday, December 5. This group will meet at the College Reunion Desk in the Registration Foyer of the Hotel Statler at 12:00 noon. Write E. C.

Lawson, Head of Mechanical Engineering, University of North Dakota, Grand Forks, N. Dak.

The Ohio State University: Alumni are invited to meet with Dean Gordon B. Carson at the McAlpin Hotel, Thursday, December 5. The get-together starts at 6:00 p.m. followed by dinner after which Dean Carson will speak on "Ferment in Engineering Education." This invitation includes wives of alumni. Write T. T. Frankenberg, American Gas & Electric Service Corporation, 30 Church Street, New York 8, N. Y.; phone, Cortlandt 7-5920; or Harold A. Bolz, Associate Dean, College of Engineering, Ohio State University, Columbus 10, Ohio.

Pratt Institute: Dinner meeting at 6:30 p.m. at Keen's Chop House on Thursday, December 5. Reservations through Prof. K. E. Quier, Pratt Institute, Brooklyn, N. Y.; phone, Main 2-2200.

Rensselaer Polytechnic Institute: Luncheon at the Statler Hotel, Thursday, December 5, 12:30 p.m. There will be reserved tables in the Cafe Rouge, inquire for location. Write E. H. Dion, secretary, Rensselaer Alumni Association, Inc., 10 East 43rd Street, New York 17, N. Y.; phone, Murray Hill 2-5350.

Stevens Institute of Technology: Reunion Luncheon will be held at 12 o'clock noon, Thursday, December 5, at the Stevens Metropolitan Club, 106 West 56th Street, New York, N. Y. Write Victor C. Lawrence, secretary, or phone Circle 7-0040.

Tufts University: Reunion Luncheon, Thursday, December 5, 12:30 p.m., at Zeta Psi Club, write Frederick J. Flynn, Jr., 224 Eleventh Street, Garden City, N. Y.; or phone, Pioneer 7-0012.

Virginia Polytechnic Institute: Reunion Dinner meeting of the New York and New Jersey Chapters of the VPI Alumni Association, Thursday, December 5, at 6:00 p.m., at the Fifth Avenue Hotel. Call Charles Lutz at Algonquin 5-4800.

Worcester Polytechnic Institute: Reunion Dinner, Thursday, December 5, at Rosoff's Restaurant. Cocktails at 5:30 p.m. and dinner at 6:30 p.m. Call Edward Dahill at Murray Hill 7-9226.

Yale University: Annual "Football Smoker, Thursday evening, December 5 at 8:00 p.m. on the 18th Floor of the Yale Club. Members of the team will be present. Movies will be shown covering the high lights of the season's games. All Yale Alumni attending ASME meetings are invited to attend. Write or call Conrad Hunter, c/o William E. Hill & Company, Inc., 640 Fifth Avenue, New York 19, N. Y.; phone Judson 2-5959.

If your school is not listed here, stop at the College Reunion Desk in the Registration Foyer of the Hotel Statler upon your arrival for additional information.

Inter-American Manufactured Products and Raw Materials Standards on Way

INTER-AMERICAN standards for manufactured products and raw materials—a basis for Western Hemisphere trade and a boon to good will—will be established according to a resolution by the Inter-American Meeting of Experts on Standardization. Cyril Ainsworth, technical director of the American Standards Association and a delegate to the meeting, made the first public report in New York, N. Y., October 10, on the meeting in Rio de Janiero, September 23-28. The meeting, the first of its kind, was organized by the Inter-American Economic and Social Council of the Organization of American States.

Standards Basic to Science

"These standards, when established," Mr. Ainsworth said, "will be basic to science and engineering, indispensable to industry, and a vital factor in promoting commerce and trade. These standards can make a major contribution to the economy of each country and can promote good will among all."

He reported that the committee urged the establishment of a national standards body in every country that does not have one. The committee took the first step toward the development of standards bodies where they are not in operation, according to Mr. Ainsworth, by stating the broad, fundamental principles underlying the formation of these bodies. These principles can be adapted to meet the particular conditions in the individual countries.

The committee recognized that the only effective standards are those which are mutually acceptable to all parties affected by them, and while it recognized that government participation in standards work is highly desirable, the group contends that these standards must be developed under the guidance of an organization which brings together the producer or manufacturer, consumer or user, the technical expert, and the government. "Such an organization would be much like the ASA in the United States," Mr. Ainsworth added.

Standards Laboratories

The committee also outlined the basic principles for setting up standards laboratories. Mr. Ainsworth pointed out that the standards institutes that are planned would be completely ineffective unless each should have the support of standards laboratories, to determine whether raw materials or manufactured items actually comply with the standards under which they are bought and sold.

A resolution to translate the standards of each country into the four languages used in the Americas was adopted. Mr. Ainsworth explained that a single misunderstanding between firms in a commercial transaction can cause a loss far in excess of the cost of translating a thousand standards, and could cause untold damage to relations between countries.

The meeting urged the gradual conversion to the metric system of weights and measures in industry. The U. S. delegation abstained from voting.

"Recognizing that some countries use nonmetric units now," Mr. Ainsworth said, "the group recommended the development of common points between systems so as to bring about convenient interchangeability of items manufactured under the several systems."

The committee further developed a plan for all Inter-American countries which do not now participate in international standards such as are developed through the International Organization for Standardization to take part.

U. S. Delegates

In addition to Mr. Ainsworth, other delegates to the meeting were: A. T. MacPherson, associate director, National Bureau of Standards, Vincent E. Bower, also of NBS, Richard C. Sogge, manager, Standards Engineering, General Electric Company (nominated by the American Standards Association); Willis MacLeod, director, Division of specifications, General Services Administration; Edwin W. Ely, Office of Technical Services, U. S. Department of Commerce; Robert Painter, executive secretary, American Society for Testing Materials; and Allan Bates, Portland Cement Association (nominated by ASTM).

Conference Aims

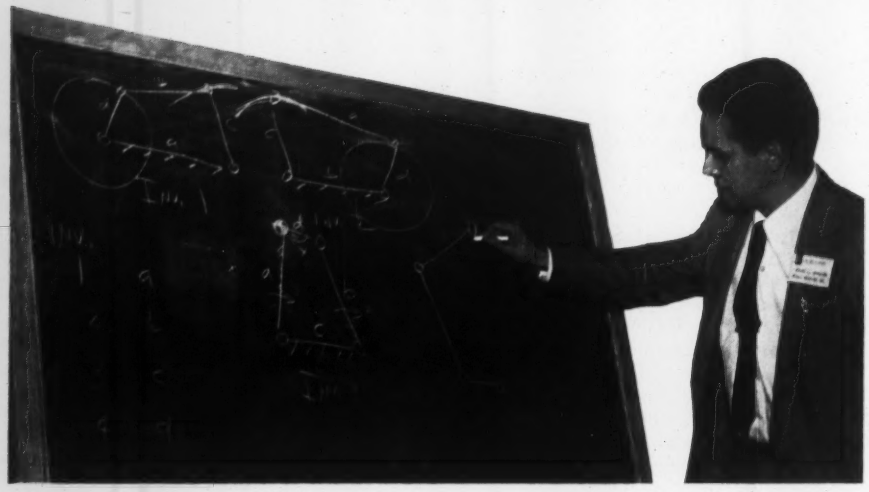
Purpose of the conference was to:

1 Stimulate interest in the objectives of standardization and its value in promoting the economic well-being of the Americas.

2 To encourage the formulation of national standards organizations in those countries which have none.

3 To encourage co-operative action by Pan-American countries in the development of Pan-American standards.

4 Finally, to encourage co-operation and participation in world-wide standardization work.



A proposal to standardize the system for notating and classifying four-bar linkages was introduced by B. L. Harding of the Heald Machine Company, Worcester, Mass.

Small gas turbines, new metals and alloys, and the future of engineering were among the high lights of the . . .

1957 ASME FALL MEETING

IF HARTFORD, Conn., achieved "the dubious distinction," in the words of Richard C. Hurd, Chairman of the Hartford Section, "of being the burial place of the Fall Meeting," the last rites were successful indeed. Over 600 attended the sessions at the Hotel Statler, Sept. 22–25, 1957, and keen interest was maintained in the technical sessions in spite of a lively background of inspection trips and social events.

A broad technical program of 55 papers was contributed by 14 different divisions. Metals Engineering and Machine Design were the most active, with 14 papers in the metals field, and 12 on machine design.

The women's program provided trips to Sturbridge Village, Mystic Seaport, and the International Silver Company. Also the women were welcome on the inspection trips to the Sikorsky Division of United Aircraft Corporation, and the Electric Boat Division of General Dynamics Corporation as well as a clambake.

Luncheons and Banquet

Engineers heard two discerning appraisals of their profession in the luncheon address of ASME President W. F. Ryan, and the banquet address of Gaylord P. Harnwell, president of The University of Pennsylvania.

President Ryan was introduced by Dwight Douglass, Mem. ASME, vice-president of The Connecticut Power Company. Dr. Ryan's address on the need for "A Survey of the Engineering Profession," for which preliminary research was recently initiated, is published in this issue of MECHANICAL ENGINEERING. A comparison is drawn between the condition of the medical profession prior to Abraham Flexner's 1910 survey, the prestige which developed largely as an outgrowth of that survey, and the implications for the engineering profession.

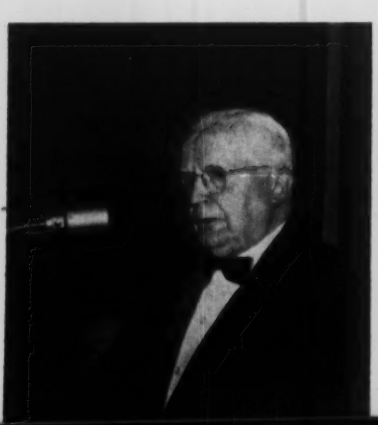
Dr. Harnwell considered the present status of engineering against the background of recorded history. He asked, when in considering what will characterize our age and America's contribution—in the light that we consider Roman Law or Greek art and architecture as contributions of other eras—will ours be one of tolerance and consideration for the rights of man, will the arts have a place, or will technology be a leading contributor?

Certainly the technical contributions of the engineer have been great, he said, and through the development of new instruments and methods like the nuclear techniques for research—such as radio-isotopes; and for synthesis, such as polymerization; the engineer is on the threshold of major contributions to the sciences.

"Because of his ability to think quantitatively, precisely, carefully, and imaginatively, he is looked upon also as a human bridge of understanding between the scientific method and such components of our society as are represented in business and industry, and government."

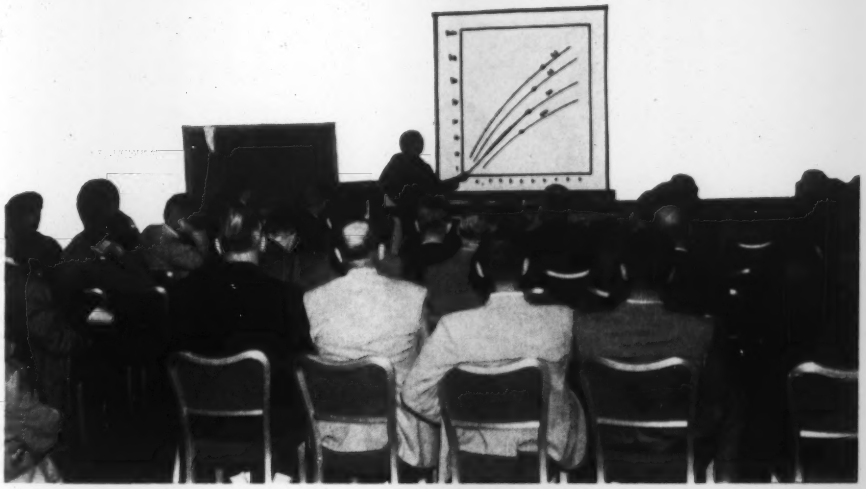
If the engineer is to continue to serve as an effective interpreter, Dr. Harnwell continued, he must "have abiding concern" for men and their characteristics, and respect for their backgrounds and differences. He must comprehend the impact of history and be mindful of the fact that increasing specialization has brought increasing separation of groups because of lack of understanding.

He must have a grasp both of the material way in which problems may be solved and the way in which the solutions can be applied to his own neighborhood and in the larger sphere. To skill and comprehension must be added



The future of every engineer depends on "A Survey of the Engineering Profession," that was recently initiated, according to ASME President William F. Ryan, *left*, who spoke on that topic at the President's Luncheon

Engineers are becoming a human bridge of understanding with the increasing complexity of scientific and technological developments, according to Gaylord P. Harnwell, *right*, president, University of Pennsylvania, who addressed the banquet

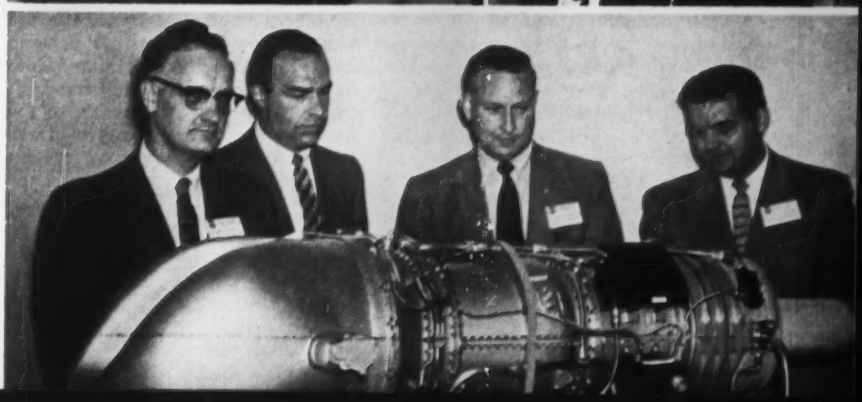


Illustrating a point on "Functional Analysis to Final Design of a Steel Casting," presented by R. J. Franck at a Metals Engineering Session.

At the speaker's table for the ASME Banquet were, *left to right*, ASME Secretary C. E. Davies; W. H. Byrne, Vice-President of ASME Region II; F. W. Miller, Vice-President of ASME Region III; C. H. King, Jr., president, Connecticut Valley Section, American Rocket Society; R. C. Hurd, chairman, Hartford Section, ASME; Roger Ladd, Hartford City Councilman; Speaker Harnwell is hidden; C. H. Coogan, Jr., General Arrangements Committee chairman; Bishop Grady

Continuing the speaker's table at the ASME Banquet, *left to right*, Rt. Rev. Walter H. Gray, Bishop of the Episcopal Diocese of Connecticut; ASME President W. F. Ryan; Paul Eddy, president, Society of Automotive Engineers; C. E. Crede, Vice-President ASME Region I; Mrs. R. C. Hurd, chairman, Ladies' Committee; H. S. Aurand, Vice-President-Elect, Region VII of Hawaii; ASME Secretary-Elect O. B. Schier, 2nd

The design of steel castings was the topic of this Metals Engineering Session group. *Left to right*, William Berry of Westinghouse, acting vice-chairman; G. K. Dreher, Steel Founders' Society of America, acting chairman; authors: W. C. Pierce, Warner Electric Brake & Clutch Company, Assoc. Mem. ASME; David Zuege, Sivyer Steel Casting Company; and R. J. Franck, Superior Steel & Malleable Castings Company.



The 250-lb T58 turboshaft engine designed for the Navy by General Electric is shown to a group of Fall Meeting attendees by Lawson W. Waitt, *left*, who presented a paper on some of the problems involved in producing engines of such small size

President's Luncheon group, *left to right*, C. H. Parsons, chairman, ASME Meetings Committee; C. H. Coogan, Jr., general chairman, ASME General Arrangements Committee; C. E. Crede, Mem. ASME; ASME President William F. Ryan

dedication and thorough knowledge of his society. Then the engineer will be known not only as a maker of better materials, and developer of finer techniques, but "as creator of a more wondrous United States, and—I fervently hope—of a better world!"

Charles H. Coogan, Jr., Mem. ASME, head of the mechanical-engineering department, University of Connecticut, was toastmaster at the banquet.

Technical Sessions

Reduction in the size of gas turbines was of considerable interest in the technical sessions. The general design considerations, the dynamic response characteristics, and the problems overcome in manufacturing the T58 General Electric gas turbine were the topics of papers which provided a summary of current developments in a session jointly sponsored with the Aviation Division.

The T58, which weighs only 250 lb, delivers 1050 military hp. Tolerances were extremely critical for this reduction in size from the 2520-lb J47, and a number of innovations were made in machining techniques. Unusual skill was required for hand-finishing operations so that dimensional accuracy would not be lost.

All tolerances were checked with electronic tracer control which utilizes spark gap to keep a stylus at a constant 0.001 in. from the blade, outlining its form and thus preventing any damage from contact with the blade.

Fuel consumption can no longer be regarded as a problem with gas turbines. Reciprocating engine consumption in the 80 to 100-per-cent-load region has already been undercut although this is not true for lower loads. Consideration was urged of the vortex-type combustion chamber which is being actively developed in Germany. The integral combustion chamber offers an unusually simple design.

Other gas-turbine papers dealt with industrial and marine applications. One of these, titled "A 1500-Hour Accelerated Service Test on Two Shipboard Gas-Turbine Engines," will be published in MECHANICAL ENGINEERING.

A paper on the "Thermodynamic Properties of Compressed Water," presented at the session on Heat Transfer and of particular interest in view of the chart recently published by ASME, appeared in the October, 1957, issue of MECHANICAL ENGINEERING, pp. 939-943.

Production Engineering joined Management for a session on production controls, and presented papers on the use of numerical systems for the automation of machine tools at another session.

Metals Engineering papers ranged from the properties of various classes of metals, and specific alloys such as a 225,000-psi commercial cast steel, to problems in fabrication and process controls.

Several films were presented at these sessions. One showed the steps in pouring, Thermit-welding, and machining of a 450,000-lb casting; another produced by the Steel Founders Society of America was on "Photoelastic Studies of Joining Sections in Steel Castings and Weldments."

The Machine Design Division joined the Safety Division in presenting a panel on integral "Safety in Machine Design" at the initial session, and joined the Textile Division for two sessions of particular interest to that New England industry. At other Machine Design sessions, papers dealing with a numerical method for determining cam-follower response; the desirability of standardizing notation and classification of four-bar linkages; and on the control of steam ejectors for mixing were presented.

A panel discussion on "What Can A Young Engineer Do To Develop Professionally?" considered the attributes of successful engineers, particularly the importance of personal attitudes; and the means for formal and informal educative advancement.

The part played by materials handling in production and inventory control, the use of analytical methods, the construction of mathematical models were topics presented in sessions of that division.

Other sessions pertaind to the fields of hydraulics, applied mechanics, lubrication, and education.

Digests of available papers will appear in this and subsequent issues of MECHANICAL ENGINEERING.

Availability List—1957 ASME Fall Meeting Papers

THE papers in these lists are available in separate copy form until July 1, 1958. Please order only by paper numbers; otherwise the order will be returned. Copies of these papers (25 cents to members; 50 cents to nonmembers) may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
Applied Mechanics	
57—F-1	High-Order Accuracy in the Solution of Partial Differential Equations by Resistor Networks, by H. G. LANDAU
57—F-3	Tensor Flexibility Analysis of Closed-Loop Piping Systems, by J. W. SOULE
57—F-4	Torsion and Flexure of Slender Solid Sections, by W. J. CARTER
57—F-5	Natural Frequencies of Non-uniform Beams on Multiple

President's Luncheon, continued, *left to right*, Dwight Douglass of the ASME Technical Events and Publicity committees; Senator Elmer Watson; R. C. Hurd, chairman, Hartford Section; H. L. Spaunberg, chairman, Reception Committee; W. F. Thompson, Mem. ASME

Elastic Supports, by R. A. Di Taranto

57—F-6 Bending Frequency of a Rotating Cantilever Beam, by M. J. Schilhansl

57—F-7 Force in the Plane of Two Joined Semi-Infinite Plates, by J. T. Frasier and Leif Rongved

Gas Turbine Power

57—F-13 General Design Consideration for Smaller Gas Turbines, by W. T. von der Nuell

57—F-20 Manufacturing Small Engines, by L. W. Waitt

57—F-21 Shipboard Gas-Turbine Engine Tests, by P. W. Pichel, D. E. Blackwood, and W. P. Henry, Jr.

57—F-22 Dynamic Response Characteristics of Gas Turbines, by S. L. Soo and W. W. S. Charters

57—F-31 Design Features of a Gas Turbine for a Supercharged Boiler, by J. M. Baker, J. B. Gilbert, and W. B. Moyer

57—F-38 The Industrial and Marine Applications of Lycoming Gas Turbines, by K. A. Austin

Heat Transfer

57—F-8 Total Normal Emissivity Measurements for Mass-Transfer Cooling, by T. F. Irvine, Jr., J. P. Hartnett, and E. R. G. Eckert

57—F-9 Thermal Conductivity of Insulating Materials for Use in Nulcear Reactors, by W. R. Morgan and W. G. Baxter

57—F-10 Thermodynamic Properties of Compressed Water, by T. C. Tsu and D. T. Beecher

57—F-29 Heat Transfer to Fluids with Low Prandtl Numbers for Flow Across Plates and Cylinders of Various Cross Section, by R. J. Grosh and R. D. Cess

Hydraulic

57—F-19 Losses in Flow Normal to Plane Screens, by W. G. Cornell

57—F-30 Method for Prediction of Boundary-Layer Separation and Growth for Application to Turbine-Blade Design, by B. A. Jones

Lubrication

57—F-12 Solution of Reynolds' Equation for Finite Journal Bearings, by O. Pinkus

57—F-18 Theoretical and Experimental Analysis of Hydrodynamic Gas-Lubricated Journal Bearings, by B. Sternlicht and R. C. Elwell

57—F-34 Isoelasticity in Gyro Rotor Bearings, by F. W. Ortman and H. M. Green

Machine Design

57—F-15 Control of Steam-Jet Vacuum Pumps, by C. G. Blatchley

57—F-16 Modern Textile Motors, by J. B. Wren

57—F-17 A Numerical Method for Determining Cam-Follower Response, by H. A. Rothbart

57—F-23 Modern Adjustable-Speed Drives for Textile Machinery, by A. T. Bacheler

57—F-24 Power Drives for Warp-Prepa-

Materials Handling Session group, *left to right*, R. B. Fetter, author; Stanley Rubinsky, session vice-chairman; authors: A. F. Gould and H. P. Galliher

A rapid numerical method for determining cam-follower response was presented by H. A. Rothbart, Mem. ASME

John W. Soule indicates a fundamental formula in tensor flexibility analysis of closed-loop piping systems

ration Machines, by GEORGE MANNING

57—F-28 Proposed Standardized System for Notation and Classification of the Four-Bar Linkage, by B. L. HARDING

57—F-33 D-C Braking of A-C Motors in the Textile Industry, by J. C. MAROUS

Management

57—F-2 Project Control in Engineering Development, by G. L. THUERING

57—F-11 Organize Your Engineering Project, by M. TOURTELLOTTE

57—F-36 Control of Engineering Work in a Product-Development Laboratory, by R. W. BARBER

Materials Handling

57—F-25 Waiting-Line Models in Materials Handling, by H. P. GALLIHER and R. B. FETTER

57—F-26 Analytical Methods for Materials-Handling Analysis, by A. F. GOULD

57—F-27 Materials-Handling System for Job-Shop Production Control, by J. R. MANDEL

Metals Engineering

57—F-37 Weld Fabricated and Repaired Steel Castings for Nuclear Service, by SIDNEY LOW

Production Engineering

57—F-14 The Use of Numerically Controlled Machine Tool, by M. V. HAYES

Safety

57—F-32 The What of Safe Design, by N. PRASINOS

57—F-35 The Why of Safe Design or Why Safety Engineering in Design? by J. V. GRIMALDI

ASME Codes and Standards Workshop

Alfred Iddles Named Chairman of Reactor Safety Committee

ALFRED IDDLES, Fellow ASME, director, The Babcock & Wilcox Company, has been elected chairman of ASA Sectional Committee N6, Reactor Safety Standards. The Sectional Committee held its first meeting September 19 in the Engineering Societies Building, New York, N. Y.

Alfred Iddles Heads Reactor Safety Committee

Mr. Iddles has been active in the Society's codes and standards work and represented ASME on ASA Mechanical Standards Board and Standards Council. He is president of Atomic Industrial Forum.

Harold Etherington, Mem. ASME, of the American Car and Foundry Corporation, was elected vice-chairman.

The Sectional Committee authorized appointment of a Steering Committee, which was to prepare a plan of organization, to be presented on the basis of function (containment, shielding, etc.) rather than on type of reactor (power, research, etc.).

New Standards Available

Machine Mounting Specifications for Abrasive Discs and Plate-Mounted Wheels ASA B5.35–1957, $1.50.

American Drafting Standards Manual

ASA Y14.1–1957 Size and Format, $1

ASA Y14.2–1957 Line Conventions, Sectioning, and Lettering, $1.50.

ASA Y14.4–1957 Pictorial Drawing, $1.50.

ASA Y14.5–1957 Dimensioning and Notes, $2.

Copies of the afore-mentioned are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Interpretations of 1955 Code for Pressure Piping

Case 28, published in the September, 1957, Standards Workshop, has been approved for use under Sections 1 and 5.

ASME Elects New Officers by Letter Ballot

AS REPORTED by the tellers of elections, 1958 officers, J. H. Lawrence, T. R. Olive, and W. H. Larkin, letter ballots received from members of The American Society of Mechanical Engineers were counted on Sept. 24, 1957. The total number of ballots cast was 12,261; of these 142 were thrown out as defective.

	Votes for	*Votes against*
For President		
James N. Landis	12,100	19
For Regional Vice-Presidents—serve two years		
Charles E. Crede	12,094	25
Arthur W. Weber	12,087	32
Ernest W. Allardt	12,090	29
Henry S. Aurand	12,084	35
For Directors —serve four years		
Elmer O. Bergman	12,090	29
Louis N. Rowley, Jr.	12,074	45
Ronald B. Smith	12,081	38

The new officers will be introduced and installed in office during the 1957 Annual Meeting of the Society to be held at the Statler and McAlpin Hotels, New York, N. Y., December 1 through 6.

Biographical sketches of the newly elected officers were published in the August, 1957, issue of MECHANICAL ENGINEERING, pages 811–815. ASME Annual, AC-10, published early each year contains complete lists of officers and personnel composing the Council, Boards, and Committees of the Society.

ASME and ASLE Sponsor Canada's First Lubrication Conference

Lubrication engineers, meeting in Toronto, receive reports on the London Conference, and hear a first-hand account of Russian Technical Literature

An engineering Conference of international scope took place Oct. 7–9, 1957 at Toronto, Canada. The Lubrication Division of The American Society of Mechanical Engineers met with the American Society of Lubrication Engineers in a Conference sponsored jointly by the two American societies in co-operation with their Ontario Sections and with the Engineering Institute of Canada. More than 330 engineers from four countries gathered at Toronto's Royal York Hotel to hear and discuss the latest findings in the growing science of lubrication.

City on the Lake

Toronto, the city in which Sir Frederick Banting and Dr. Charles H. Best discovered Insulin, is the capital of Ontario, a Province about the size of Texas and New Mexico combined. Its Royal York Hotel is said to be the largest in the British Commonwealth (they prefer "Commonwealth" to "Empire"). Montreal's new Queen Elizabeth Hotel will be bigger, but the Toronto giant is building an addition. Montreal can't win. Visiting engineers who felt the urge to speculate, found they had available the second largest stock exchange in the world.

Fittingly enough for the joint conference of the engineering societies, the Indian name "Toronto" meant "place of meeting."

President W. F. Ryan, of the ASME, and president J. O. McLean, of the ASLE, both came to Toronto for this first lubrication conference ever to be held in Canada. They heard papers on lubrication research of a nature scarcely dreamed of ten years ago.

The New Lubricants

Today's lubrication engineer finds himself dealing with problems of temperature, pressure, and contamination that call for revolutionary concepts. For a lubricant, he may use water, liquid metals, solids, or gases—including air. Air shows an increase in viscosity with temperature, making it a choice for high-temperature lubrication, but it has little load-carrying capacity—hence research on the high-pressure air bearing.

For nuclear plants, the working fluid may be called on to serve as lubricant, since oil would deteriorate under radiation. Oil would also get into the system and cause pressure rise and foaming, and poor heat exchange. The solution: Lubricate with the working fluid, possibly high-purity water. Or, go to a liquid metal such as sodium-potassium eutectic, with its low melting point.

It is the nature of the new aircraft jet engines that they will demand lubricants efficient over a great temperature range. Where piston engines could be operated economically at cruising power, the jet cannot. The future will see air liners climbing to cruising altitude (perhaps 60,000 ft) then shutting down some of their engines, permitting full-power operation of the working engines. Yet, the oil in the cold engines must flow for restarting, and must also endure extreme high temperatures in operation.

On Monday, Oct. 7, the Joint Conference got under way in the Royal York's Concert Hall. For this gathering, the American Flag and the Canadian Ensign both flew from high on the wall behind the speakers' platform.

Report From London

The first technical session heard and discussed papers from Westinghouse (wear of surfaces in high-purity water), The Franklin Institute (a study of wear at high contact pressures), The Ethyl

National ASME officers and local leader. ***Left to right:*** **President W. F. Ryan, D. F. Quan, Chairman, Ontario Section, and O. B. Schier, 2nd, Secretary-Elect.**

Presidents of both American societies attend the meeting. W. F. Ryan of the ASME, and J. O. McLean of the American Society of Lubrication Engineers.

The registration desk. ***Left to right*** **are H. A. Hartung, ASLE, vice-chairman, and E. E. Bisson, ASME, Chairman of the Toronto Conference.**

Report from Europe. Just returned from the London Lubrication Conference are Ernest Rabinowicz, *left,* of M.I.T., and H. A. Hartung, of Atlantic Refining.

Corporation (radioactive piston-ring studies), and the Ford Motor Company (oxidation in high-speed friction). In the afternoon, the Conference heard a report by Ernest Rabinowicz, of M.I.T., on the London conference which had ended only three days before. This was the International Conference on Lubrication and Wear, sponsored by England's Institution of Mechanical Engineers.

Prof. Rabinowicz found his audience eager and attentive when he described the Russian papers presented at London, and when he described the general trend of the Russian Technical Literature. Toronto, according to published charts, was under the path of the Russian artificial satellite which had been launched the previous Friday.

Russian Technical Literature

Of six Russian papers at London, two reported experimental findings, and four were mainly theoretical, according to Prof. Rabinowicz. This, he said, would be unusual, here. The Russians appeared to be ignorant of findings that have been published in well-known Western literature, but they treasure their own reports. They are quick to produce a bound volume of reports and transactions. In general, they have the advantage of knowing English better than we know Russian.

The afternoon session also heard papers from the Sinclair Research Laboratories (cutting-tool wear, and cutting-tool action), and General Electric (liquid-metal lubrication).

On Monday evening, there took place the "Presidents' Reception"—also in the Concert Hall—with presidents Ryan and McLean there to meet the 330 engineers who had assembled from the United States, Canada, England, and Denmark. Also present were O. B. Schier, 2nd, Deputy Secretary of the ASME, and C. L. Willey, Administrative Secretary of the ASLE.

Keeping It Informal

There were no formal speeches at the dinner. Both presidents spoke briefly and off the cuff. Dr. Ryan expressed the pleasure he always feels at joint conferences of engineering societies, and urged the conferees to get to know each other. The social side of these gatherings, he said, should not be neglected.

Thereafter, the Conference adhered strictly to business. On Tuesday, Oct. 8, the morning session heard papers emanating from General Electric, The Lewis Flight-Propulsion Laboratory (N.A.-C.A.), and M.I.T. In the afternoon, there was another paper from the Lewis Flight Propulsion Laboratory, one from Hyatt Roller Bearing Division of General Motors, and one from the Wright Air Development Center.

On Wednesday morning, Prof. E. A. Allcut, Fellow ASME, head of the Mechanical Engineering Department of the University of Toronto, served as chairman. The session heard a second report on London. H. A. Hartung, of Atlantic Refining, took up the London papers individually, giving the Toronto Conference a careful briefing on the developments across the Atlantic. The session also heard a paper from Westinghouse, and one in which the authors were from Columbia University and General Electric.

At the final session, there were papers from M.I.T., the Franklin Institute, and the Carnegie Institute of Technology.

Availability List—1957 ASLE-ASME Lubrication Papers

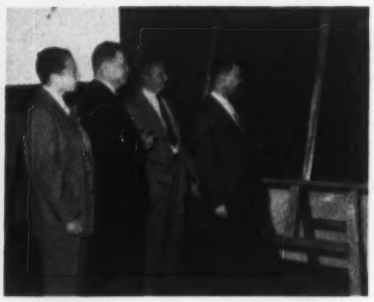
THE papers in this list are available in separate copy form until August 1, 1958. Please order only by paper numbers; otherwise the order will be returned. Copies of these papers (25 cents to members; 50 cents to nonmembers) may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	*Title and Author*
57—LUB-1	On Friction and Lubrication at Temperatures to 1000 F with Particular Reference to Graphite, by E. E. Bisson, R. L. Johnson, and W. J. Anderson
57—LUB-2	Self-Excited Vibrations of an Air-Lubricated Thrust Bearing, by L. Licht, D. D. Fuller, and B. Sternlicht
57—LUB-3	Surface Deformations in the Hydrodynamic Slider-Bearing Problem and Their Effect on the Pressure Development, by F. Osterle and E. Saibel
57—LUB-4	Current Development Problems in High Temperature Aircraft Roller Bearings, by C. C. Moore and P. Lewis
57—LUB-5	The Behavior of the Lubricating Film and Side Leakage Dynamically Loaded Bearings, by M. N. Ozdag

Technical Session, *left to right:* E. B. Sciulli, R. G. Abowd, Jr., Mem. ASME; N. B. Dewees, A. C. West, S. Beaubien, Mem. ASME; and M. Cocks

At the first "authors' breakfast." Seated is ASME President Ryan. Speaking to the Monday authors is E. E. Bisson, Chairman of the Conference.

***Left to right:* C. L. Goodzeit, A. Dorinson, L. F. Coffin, Jr., and E. Rabinowicz. Goodzeit, General Motors, and Coffin, General Electric, are Mem. ASME.**



Junior Forum

Conducted for the National Junior Committee

By H. N. Weinberg,[1] Assoc. Mem. ASME

Professional Development for the Young Engineer

By Roger W. Honebrink[2]

One of the most critical shortages in American industry is that of competent technical personnel; and the problem shows every indication of getting worse before it gets better. This shortage presents a tremendous challenge and opportunity to the professional engineer to maximize his personal contribution to the maintenance of both our high standard of living and our technological position with respect to other world powers. To take advantage of that challenge and opportunity, each engineer needs to give particular attention to his own professional development.

A Planned Program. An extremely important feature for any personal, professional development program is that it should be a planned program. Furthermore, the plans should be concise and concrete, and should be written down and scheduled. They should not be vague notions carried in the back of the head, to the effect that "This is something I ought to do some day." It is highly unlikely that any development plan will be carried out completely without change. As an individual grows and learns he invariably readjusts his goals and ambitions. However, the important thing is to get started actively in some direction, even though this direction is subject to change. If a start is not made, no progress can be expected.

By the very act of sitting down and laying out a plan for himself, the engineer will surmount three major obstacles in the way of professional development:

1 He will have recognized the need for his personal development.

2 In the process of developing his plan he will be obliged to analyze his professional needs in the light of his job desires and the abilities he already has.

3 By laying out a scheduled program he will establish concrete goals by which he can measure his progress.

In this, as in many tasks, the first step is probably the most difficult, or at least the most crucial one. In our current atmosphere, the young engineering graduate is highly sought after—he is flattered, impressed with his own ability and importance, and all but guaranteed professional success by as many industrial recruiters as he cares to interview. All too often the individual's effort in achieving this success is glossed over lightly, and the engineer arrives on the job with the attitude that he has done his part and it is now the responsibility of industry to do the rest. When he comes to the realization that his professional development has only begun and that the primary responsibility for its continuance rests solely with him, he will have taken a major step toward becoming a true engineer.

Learning by Doing. The principle of learning by doing is deceptively simple and yet profoundly important. It has been well recognized in many fields such as arts and sports. A person who aspires to be a professional singer spends long hours singing, and no golfer would expect to break par by merely reading books on the subject. Similarly the engineer who desires to develop a particular ability should strive to put himself into situations where he will need to apply that kind of ability. These situations might take the form of work experiences, educational courses (provided significant effort is required of the student), or even social activities.

Since many of the attributes of the professional engineer are nontechnical, the value of social activities in professional development should not be underestimated. For instance, the man whose personal inventory of abilities reveals a deficiency in the oral presentation of ideas can do a great deal for himself by joining a public speaking club such as the Toastmaster's Club, as well as by taking a formal public-speaking course. Similarly, the man who feels a need for developing his leadership ability can obtain valuable experience and can learn by doing by volunteering for offices in church or social groups.

Of course, our educational institutions and many of our industrial concerns offer planned courses or programs to the engineer in a great number of both technical and nontechnical fields. These represent gold-plated opportunities to the engineer who is truly interested in professional development. Indeed, human nature being what it is, the engineer will generally be more successful building his personal development program around well-structured courses offered by schools and industry than by trying to work out and accomplish an informal program in detail by himself.

Technical Development. Although the technological requirements of industry are multiplying daily, most young engineers do not suffer from a lack of knowledge of physical laws and effects. Actually the great majority of engineers will never use a physical fundamental that is beyond the scope of a college sophomore physics course. The great hindrance to technical performance is in the lack of ability to apply these fundamentals to real engineering problems. This ability to apply fundamentals requires not only a knowledge of, but a thorough understanding of physical laws and effects, and this is why education beyond the sophomore physics course is required. In addition, mathematics is a universal tool in the application of physical fundamentals. Frequently the application of the simplest physical laws, for instance Fourier's Law of thermal conduction, can be applied with precision to a real problem only by virtue of mathematics well beyond the college-graduate level. Like any other qualities, a thorough understanding of physical principles and the ability to use mathematics are best acquired by learning by doing, which in this case involves actual application to real problems.

After over 30 years of evolution, General Electric's engineering education programs emphasize two major philosophical areas that contribute to the engineer's problem solving effectiveness:

1 An organized approach to engineering problems

2 Personal outlook and attitudes.

A Problem Approach. An engineering problem is most effectively solved by following a logical sequence of steps. A general "problem approach" has the following steps:

1 Recognize the problem

2 Define the problem

3 Search for methods of solution

4 Evaluate the methods

5 Select a method

(Continued on page 1109)

[1] Process engineer, Esso Research and Engineering Company, Linden, N. J.

[2] Supervisor, Advanced Technical Programs, General Electric Company, Schenectady, N. Y.

* ASME Engineers in Tulsa for Conference ...Petroleum Is the Word in Oil Capital

BEAUTIFUL music and eloquent words were wed 14 years ago, in the midst of a world war, to mark Oklahoma OKay! Rich in agricultural and mineral resources, oil men claim for Oklahoma yet another honor, for within her boundaries is Tulsa—oil capital of the world. Since 1901 when oil was discovered in nearby Red Fork, hundreds of oil companies and allied industries have been located in Tulsa and, jointly, control a large segment of the oil-industry operation, not only in America, but the world.

Consequently, it was no surprise when more than 800 engineers came to Tulsa to be on hand for the twelfth annual Petroleum Mechanical Engineering Conference of The American Society of Mechanical Engineers held September 22 through 25, at the Mayo Hotel. The meeting was sponsored by the ASME Petroleum Division with the co-operation of the Mid-Continent Section.

The conferees, who, in the main, are engaged in the petroleum industry and concerned specifically with research, refining, production, transportation, manufacture, or one of the industries associated with petroleum, came from the United States, Canada, Venezuela, and far-off Israel.

Innovation in Registration

For the first time at an ASME meeting, information about registrants and their technical interests was put on punch cards for analysis on McEvoy Company's UNIVAC computer, in Houston, through the courtesy of A. F. Rhodes, a member of the Petroleum Division Executive Committee. The analytical results will be of assistance in planning future petroleum conferences to better serve the interests of attendees and the industry; an industry which put mechanical "brains" into its processes long before "automation" was coined.

Full Social Program

An informal "Get Acquainted" reception, Sunday evening, opened the social program. Early arrivals in large numbers accepted the cordial invitation of the Tulsa Arrangements Committee and soon old friends were up to date on the news and circles grew larger to make room for new acquaintances. The cordiality of this association carried over and pervaded the following functions.

Long before the appointed time for the Welcoming Luncheon, Monday noon, the Crystall Ballroom was full to capacity. Mayor George E. Norvell welcomed the engineers to Tulsa and told a little of the city's history in relation to Oklahoma's development since it became a state in 1907, fifty short years ago. He took pride in pointing out to the visitors the International Petroleum Exposition, one of the world's largest devoted to any single industry, and acknowledged the engineer's contribution to the city's development. He was introduced by W. C. Moody, chairman, Tulsa Arrangements Committee. [The Tulsa group. . . have accomplished splendid committee work on problems of keen local interest, such as automatic pumping stations. The latter has culminated in the building of a demonstration automatic pumping station at the Petroleum Exposition which has received a good deal of favorable comment. Excerpt from Transactions of the ASME, 1930.—Editor.]

C. H. Shumaker, Vice-President, Region VIII, ASME, thanked the Mayor for the gracious manner in which the visitors were received. Then he succeeded himself as principal speaker. He gave an illuminating talk on the problems facing engineering institutions due to the lack of educational facilities. Further he noted that difficulties confront college admissions boards in selecting students with the ability to successfully complete the engineering curriculum which is becoming more and more scientific. He made a strong bid for the training of technicians—thus utilizing the talents of "doers" to best advantage. W. R. Clarke, chairman, Mid-Continent

J. Carlton Ward, Fellow ASME, and president, Vitro Corporation of America, addresses banquet audience on nuclear energy as an added source of future world power

A pause to remember. J. M. Clark, *right*, ASME Divisions Manager, receives a handsome silver tray from J. S. Rearick, chairman, Petroleum Division Executive Committee, and vice-president, manager of engineering, C. W. Nofsinger Company, Kansas City, Mo. Mr. Clark, who retires this year, was commended for his able and valued assistance to the Petroleum Division.

Section, ASME, presided at this event.

Monday evening the members of the Society and visitors were guests of the Mid-Continent Section of ASME at a reception appropriately called "Hour of Charm."

The star event of the meeting was the banquet, serving as a stage for the conferring of honors for outstanding accomplishments and services to the Society and profession, and concluded with an enlightening talk by a distinguished engineer.

J. S. Rearick, chairman of the Petroleum Division Executive Committee, introduced the present members of the committee, announced the newly appointed chairmen of various petroleum committees, and then called to the dais the following recipients of the Certificate of Award for outstanding service to the Division. They are: G. E. Nevill, A. F. Rhodes, Elton Sterrett, J. W. Young, W. J. Buxton, W. C. Moody, and M. A. Scheil.

The next presentation was the happy surprise of the evening. When J. M. Clark, retiring ASME Divisions Manager, was introduced to accept the honor, he was greeted by a standing round of applause. For his valued service to the Petroleum Division he was presented with a handsome silver tray.

The final honor to be conferred had an added local flavor. A. N. Horne, vice-president and general manager, Texaco-Cities Service Pipe Line Company, Tulsa, received his certificate of promotion to the grade of Fellow ASME from W. H. Stueve, Fellow ASME, consulting engineer of Oklahoma City, Okla.

J. C. Ward Delivers Banquet Address

Nuclear power is competitive with fossil fuels in some parts of the world today and will become competitive in some parts of the United States within a relatively few years, according to J. Carlton Ward, Jr., Fellow ASME, president of Vitro Corporation of America.

Addressing the banquet audience and using color slides to highlight his talk on "Nuclear Energy as an Added Source of Future World Power," Mr. Ward explained that atomic power is now being generated competitively with fossil fuel power in such countries as England and Italy. England cannot produce enough coal to meet its power demands. Italy has no coal.

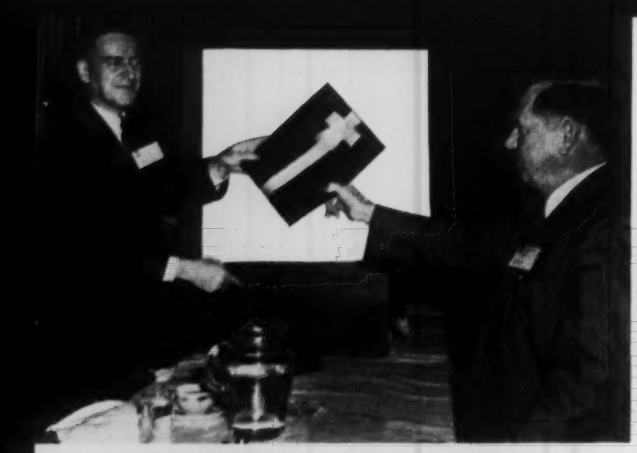
"Many people in the United States feel that Britain has moved ahead of us in the development of atomic energy by providing atomic power plants more quickly than we are or are planning. However, the point is that the British do not have the sources of raw materials for fuel that we have here in the United States," Mr. Ward said.

"They cannot produce the coal needed to run their economy, and they do not have the money to import it from the United States. Thus, they have turned to atomic energy in the quickest, easiest way . . . simply because they have to.

"We, on the other hand, are trying the engineering-scientific approach toward generating atomic energy by a wide variety of kinds of atomic plants and atomic-fuel combinations."

Atomic power will become competitive in this country first in areas where the cost of fossil fuels is high and lastly in

Some 800 engineers attend technical sessions, review petroleum industry progress, and hear J. Carlton Ward predict that competitive nuclear power is only a few years away



J. S. Rearick, *left*, chairman, ASME Petroleum Division, presents Certificate of Award to Elton Sterrett, past-chairman of the Petroleum Division Press Committee. Mr. Sterrett is engineering editor of *Pipe Line News*.

W. C. Moody, *left*, presents Certificate of Merit to J. C. Rearick, outgoing chairman of ASME Petroleum Division, for outstanding service to the Division and Society

A. N. Horne, *right*, vice-president, Texaco-Cities Service Pipe Line Company, received Fellow Grade certificate from W. H. Stueve, Fellow ASME

those areas where fossil fuels are plentiful and low in price, Mr. Ward explained.

"But this does not mean that fossil fuel producers will be destroyed by competition from atomic fission power," he added. "Oil, gas, and coal will be used in vastly increasing quantities in the chemical industry."

Commenting on thermonuclear power, Mr. Ward stated that all the known reserves of gas, coal, oil, and uranium will not be sufficient to produce the power needed to sustain the civilization we can reasonably expect in 100 years.

However, unlimited energy is provided by thermonuclear power produced by hydrogen fusion and the hydrogen in the oceans of the world can supply the power needs of civilization for more than a billion years, Mr. Ward predicted.

In view of the control problems inherent in hydrogen fusion, producers of fossil fuels and fission materials need not worry about competition from fusion power tomorrow. "But they should realize it is only a matter of time," said Mr. Ward.

The outstanding control problem in fusion is heat. Temperatures of 15 million F, required for fusion, would disintegrate any known type of furnace or reactor.

W. C. Moody presided at the banquet.

Technical Program

The technical program of 42 papers presented at 20 sessions provided up to the minute information on significant developments in the petroleum field relating to production, manufacture, transportation, refining, and new applications of materials and new materials. To round out the program two important panel discussions, led by authorities in their respective fields, covered welding design and practices, and the ASME Pressure Vessel Code.

Digests of several of the numbered papers appear in this issue of MECHANICAL ENGINEERING, pages 1060–1067; the remaining digests will be published in subsequent issues.

Production. Some excellent results with air-drilling equipment in the Pennsylvania area of the Appalachian Basin was reported. Gas production is sought in most of the holes so drilled, and their depth has been approximately 7200 ft. Results with air were poor—not up to cable tools—for the first 1000 ft due to formations and conditions encountered, but from the 1000 to 7200-ft levels penetration with air or gas was excellent. Sandstones were drilled at the rate of 30 ft per hr and shales could be "blown out" at rates up to 1000 ft per hr, hampered only by the volume of cutting it was necessary to remove in so short a time. Casing dimensions of $12\frac{1}{4}$ in., $9\frac{1}{8}$ in., and $8\frac{3}{4}$ in. were used.

Another report on drilling equipment revealed that cost savings may be obtained using wire-line retractable rock bits. The tests were conducted in the Seminole area of Oklahoma. Both a four-cone and a three-cone bit were used and the three-cone proved much more satisfactory. The report added that under proper conditions, in the mid-continent area, up to 25 per cent savings could be realized in drilling up to 7200-ft depths.

A paper on an investigation of pressure drop through a rotating pipe included findings that could be used to forecast mud pressure. The paper reported a study of pressure-loss characteristics of water flowing through rotating pipe. The results showed that the pressure drop was reduced, reaching a minimum value as the angular velocity of the pipe was increased. Applied to oil-well drilling it was indicated that a significant pressure-loss reduction may be achieved by increasing the rotary speed.

Three-legged, tripod-type drilling platforms are feasible for offshore operation in water up to 600-ft deep, according to a paper on mobile and fixed platforms. This is about six times the depth in which most offshore drilling is done now. The platform size would not have to be increased; the answer lies in spreading out the footing centers. The platform would be completely mobile—transferable from one location to another and capable of raising itself, by diesel-electric power, on its own three legs. An added feature is that it can be economically converted from a mobile-type to a permanent-type platform if desired. To achieve stability in deeper water than now drilled, the report stated, the platform will spread out its legs at predetermined angles, just like any conventional tripod. Another innovation is that most of the sections of spud legs will be carried disassembled on the deck of the platform and will be added only after the machine arrives on location.

Two papers showed the trend in automation.

The use of automatic control has resulted in increased operating efficiency, less spoilage, and a better finished product, according to a paper on automatic production of oil from a well head to pipeline. Automatic devices also are playing an important part in water-flood operations. Considerable savings were realized on the initial investment, according to a report on the Centralia Water Flood, by using the latest automatic controls and production methods. The water-flood production accounts for some 33 million barrels of oil annually in Illinois, which represents approximately 40 per cent of the total state production.

Interest in papers on materials used in piping fabrications and design drew large audience

View shows the panel which discussed welding design and practices. Panel members are, *left to right*, N. Rozek, A. O. Smith Corp., Milwaukee, Wis.; J. P. Baughman, The Dow Chemical Company, Freeport, Texas; L. C. Bibber, U. S. Steel Corp., Pittsburgh, Pa.; J. Bland, Standard Oil Co. of Indiana, Whiting, Ind.; J. J. Chyle, chairman of the panel; A. P. Maradudin, Standard Oil Co. of Calif., El Segundo, Calif.; W. H. Skewis, Midwest Piping Company, St. Louis, Mo.; and D. V. Wilcox, Reynolds Metals Company, Louisville, Ky. Bill E. Forney, seen in the background, served as vice-chairman of the panel.

R. L. Le Tourneau, *right*, vice-president, R. G. Le Tourneau, Inc., Longview, Texas, who spoke on the possibility of a drilling platform for operations in waters up to 600 ft deep, answers some questions. F. L. Manton, *left*, Diesel Power Company, Tulsa, Okla., was vice-chairman of Production Session III; Jack Marsee, chief engineer, Loffland Brothers Company, Tulsa, was chairman; and B. H. Hefner, chief electrical engineer, Electro-Motive Division, General Motors Corporation, La Grange, Ill., who was the second speaker of the session. His topic was "Advances in Diesel-Electric Rig Design for Oil-Well Drilling."

Tulsa hostesses welcome visitors to luncheon and bridge party at Tulsa Club. *Left to right* are Mrs. Earl A. Seaton, Mrs. W. C. Moody, Mrs. J. A. Wilson, Mrs. W. R. Clarke, Mrs. C. R. Hucker, Mrs. T. M. Lumley, and Mrs. E. A. Bartolina.

They all answered questions. Here a group discusses a paper presented by Howard Ferrel covering research on pressure drop through a rotating pipe which could be applied to the oil industry as a means of forecasting drilling mud-pressure needed on deep wells. *Left to right*, E. D. Fitch, Oklahoma State University assistant professor and a coauthor of the paper; Mr. Ferrell, graduate assistant, OSU; R. A. Bobo and G. A. Boudreaux, both of Phillips Petroleum Company, Houston, Texas; L. L. Payne, Hughes Tool Company, Houston; and R. M. Reed, Shell Oil Company, Tulsa. J. H. Boggs, OSU associate professor, was also a coauthor of the paper.

Top echelon meets as twelfth annual ASME Petroleum Mechanical Engineering Conference opens at Mayo Hotel, Tulsa, Okla., September 22. Seated, *left to right:* W. C. Moody, general chairman, Tulsa Conference; J. S. Rearick, chairman, Petroleum Division; and C. H. Shumaker, Vice-President, ASME Region VIII. Standing in same order: H. H. Meredith, Jr., vice-chairman, Petroleum Division; W. R. Clarke, chairman, Mid-Continent Section, ASME; J. P. Mooney of the Executive Committee; and T. L. White, secretary, Petroleum Division.

E. O. Bergman of C. F. Braun & Company, Alhambra, Calif., opens the panel discussion on ASME Pressure Vessel Code. The panel included, *left to right:* Walter Samans, consulting engineer, Philadelphia, Pa.; J. J. Murphy, M. W. Kellogg Company, New York; C. E. Rowlins, Phillips Petroleum Company, Bartlesville, Okla.; Mr. Bergman, chairman; E. C. Korten, The Hartford Steam Boiler Inspection and Insurance Company, Hartford, Conn.; F. S. G. Williams Taylor Forge & Pipe Works, Chicago, Ill.; and G. S. Chadwick, Jr., Union Carbide Chemicals Company, South Charleston, W. Va.

Transportation. An asphaltic-based protective and weight coat for pipelines laid primarily in marsh, swamp, and offshore areas was discussed. Principal advantage over concrete coating is that the asphalt-mastic coating could be applied to the job. It is also a protective coating against corrosion with sufficient ductility and durability so that it can be lowered to any bottom depth without cracking or damage, it was reported.

Revealed in a paper on military petroleum logistics was the following: Considerable progress has been made toward solution of petroleum distribution problems and the Army is confident that "with the excellent co-operation of the American petroleum industry, petroleum products will be available to the combat forces throughout the world in the quantity and quality that may be required."

The Army faces a big problem in the training of personnel to operate the distribution system. Personnel turnover is rapid since the majority of military personnel do not intend to make it a career. However, a co-operative plan has been developed whereby soldiers are assigned to oil or pipeline companies for a three-month on-the-job training course.

A paper on supervisory control of gas pipelines stated that "push-button" control offers many advantages and reduced operating costs, and more efficient line operation will convince management of the practicality of the method. The report revealed that although there is much said about automation of pipelines there are no automatic pipelines in operation today. An automatic pipeline is one which operates without human supervision from a previously programmed set of instructions. Full automation requires use of feedback in the control system and the facilities are not presently available.

Manufacturers. Three Houston, Texas, technologists presented papers on control and manufacturing problems connected with deep wells in the Gulf Coast area where 15,000-psi pressures have been encountered. One gave a detailed engineering summary of the experimental development that led to the issuance of AWHEM (Association of Well Head Equipment Manufacturers) Standard No. 6 flange. This connection has had successful field application in working with the excessive well pressures.

Another told of laboratory testing of high-pressure equipment. Demand for this equipment will increase as more wells are drilled deeper, according to this paper.

The concluding paper gave information on the design of high-pressure flanges and gaskets. Further it was reported, increase in strength of materials and the assumption of higher permissible stresses facilitated the design of flanges capable of operating under pressure.

Refining. A paper was presented showing results and procedures in eight years of operation of an inert gas-injection project in the Elk basin of northern Wyoming. Gas was generated in an Elk basin plant built for that purpose after it was found residue gas would not provide adequate pressure maintenance.

Corrosion was one of the principal problems encountered in using the flue gas. In the eight years, more than 23 billion cu ft of generated gas has been injected and this was only about 60 per cent of plant capacity. Requirements, and no inefficiency, kept the output this low, after many of the encountered problems were solved.

The use of gas turbines in refinery operations was the topic of another paper. Because of the nature of the gas turbine, there are areas in which its use may not be practical. However, there are definite areas in refinery operations where the use of gas turbines is a definite economic advantage. More and more of these areas will be defined in the next few years as the use of gas turbines increases.

Next Year in Denver

The thirteenth annual Petroleum Mechanical Engineering Conference will be held in Denver, Colo., at the Cosmopolitan Hotel, Sept. 21-24, 1958. ASME Rocky Mountain Section to be host.

Rice Memorial Scholarship Recipient Arrives in the U. S.

The National Board of the Woman's Auxiliary to The American Society of Mechanical Engineers at their meeting in Philadelphia Pa., on May 1 approved the recommendation of the Calvin W. Rice Scholarship Committee to give the award to Michel Khodr of Beirut, Lebanon. He was chosen from a list of candidates from Chile, Iraq, Norway, The Netherlands, and Lebanon submitted by The Institute of International Education of New York with which agency the committee functions in this area of endeavor. Mr. Khodr is 23 years old and was graduated in June from the American University in Beirut, Lebanon with an excellent record, having been in the upper ten of his class throughout the entire four years. Through the Institute of International Education he has been granted a Tuition Scholarship by the University of Florida. He will take courses leading to an MS in Mechanical Engineering.

The Auxiliary Award is $1500 for maintenance for a year of graduate study in the United States.

Availability List—1957 ASME Petroleum Mechanical Engineering Papers

The papers in this list are available in separate copy form until July 1, 1958. Please order only by paper number; otherwise the order will be returned. Copies of these papers (25 cents to members; 50 cents to nonmembers) may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
57-PET-1	Report on Strength of Welded Joints in Carbon Steel at Elevated Temperatures, by Special Task Group of the Petroleum and Chemical Panel of Joint ASTM-ASME Research Committee
57-PET-2	Mechanical Seals for Nonlubricating Hydrocarbons, by A. L. Decker
57-PET-3	Scheduling Engineering Design: A Vital Force in Refinery Operations, by H. T. Campbell
57-PET-4	Overstrain and Bursting Strength of Thick-Walled Cylinders, by S. M. Jorgensen
57-PET-5	Report on Results Obtained by Use of Controlled Drill-Stem Torque in Field Operations, by S. C. Moore
57-PET-6	Stress Effects of Rotary Straightening on Collapse Resistance of High-Strength Casing, by R. E. Zinkham
57-PET-7	Appalachian Basin Air Drilling . . . Three Years' Experience and Results, by H. J. Magner
57-PET-8	Experimental Development Work with 15,000 PSI Wellhead Connections, by R. C. Brooks
57-PET-9	An Investigation of Pressure Drop Through a Rotating Pipe, by Howard Ferrell, E. C. Fitch, and J. H. Boggs
57-PET-10	Surface-Controlled Subsurface Safety Device for Offshore Locations, by L. M. Wilhoit and P. S. Sizer
57-PET-11	Mobile and Fixed Platforms for Waters up to 600 Feet, by R. L. LeTourneau
57-PET-12	Military Petroleum Logistics, by H. N. Darling
57-PET-13	Modernization, by M. J. Paul
57-PET-14	Two-Phase Concurrent Flow of Liquids and Air Through Inclined Pipe, by W. E. Brigham, E. D. Holstein, and R. L. Huntington
57-PET-15	Supervisory Control of Gas Pipelines, by F. V. Long
57-PET-16	Pressure Surges in Pipelines, by E. J. Waller
57-PET-17	Positive-Displacement Meter-Proving Methods for Liquid Hydrocarbons, by M. L. Barrett, Jr.
57-PET-18	Development and Field-Testing of Wire Line Retractable Rock Bits, by J. M. Camp, J. E. Ortloff, and R. H. Blood
57-PET-19	Torque Requirements for Rotary-Shouldered Connections and Selection of Connections for Drill Collars, by A. P. Farr
57-PET-20	The Economic Aspects of Combustion Gas-Turbine Application in the Refining Industry, by C. R. Apitz
57-PET-21	Plastic Pipe in the Petroleum Industry, by G. C. Anderson
57-PET-22	Automatic Production of Oil from Wellhead to Pipeline, by E. C. Young
57-PET-23	Design Considerations for AWHEM 15,000 PSI Flanges, by Robert Eichenberg
57-PET-24	Proven Concepts in Oil-Field Roller-Chain Drive Selection, by R. A. Schakel and C. O. Sundberg
57-PET-25	Control of 15,000 PSI Well Pressures, by C. A. Dunlop and T. V. Miller
57-PET-26	Reduce Pressure Drilling, by R. A. Bono and G. S. Boudreaux
57-PET-27	A Pressure Gradient Sheet for Rating Gas Pipelines, by J. R. Berry
57-PET-28	Engineering Design, Testing, and Operation of the Gilsonite Solids Pipeline, by R. K. Bond
57-PET-29	Development and Application High-Density Asphalt Mastic Coating, by L. N. Brown
57-PET-30	Instrumentation and Controls, Centralia Water Flood, Illinois, by K. W. Foster
57-PET-31	Application of Plastic Tape to 122 Miles of 22-In. Diameter Natural Gas Pipeline, by N. E. Miley
57-PET-32	Requirements for Fabrication of Pressure Piping as Related to Service, by J. J. Murphy, C. R. Soderberg, Jr., H. S. Blumberg, and D. B. Rossheim
57-PET-33	Improving Performance of Packing and Gaskets, by R. H. Koch
57-PET-34	Eight Years of Experience With Inert Gas Equipment by G. O. Bates, J. W. Kilmer, and H. T. Shirley
57-PET-35	Design of Anchor Flanges, by A. J. Del Bosco and E. O. Waters
57-PET-36	Advances in Diesel-Electric Rig Design for Oil-Well Drilling, by B. H. Hepner
57-PET-37	Multiple Parallel String Completions, by J. R. Fresen
57-PET-38	Designing Safe Installations for Inert Gas Machines, by C. H. Evans

ASME Coming Events

Dec. 1–6
ASME Annual Meeting, Hotel Statler, New York, N. Y.

March 2–6, 1958
ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

March 16–22, 1958
Nuclear Congress, International Amphitheater, Chicago, Ill. (ASME is co-sponsor.)

March 17–20, 1958
ASME-ARS Joint Aviation Conference, Hotel Statler-Hilton, Dallas, Texas

March 19–20, 1958
ASME-AIEE Engineering Management Conference, Somerset Hotel, Boston, Mass.

March 30–April 1, 1958
ASME Wood Industries Conference, Syracuse University, Syracuse, N. Y.

April 1–3, 1958
ASME Instruments and Regulators Conference, University of Delaware, Newark, Del.

April 9–10, 1958
ASME Railroad Conference, Hotel Statler, Cleveland, Ohio

April 14–15, 1958
ASME Plant Maintenance Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 14–17, 1958
ASME Design Engineering Conference, International Amphitheater, Chicago, Ill.

April 15–17, 1958
ASME-AWS Metals Engineering Joint Conference, Hotel Statler, St. Louis, Mo.

April 24–25, 1958
ASME Management-SAM Conference, Hotel Statler, New York, N. Y.

May 18–22, 1958
ASME Oil and Gas Power Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

June 11–14, 1958
Third U. S. Congress of Theoretical and Applied Mechanics, Brown University, Providence, R. I. (ASME is co-sponsor.)

June 15–19, 1958
ASME Semi-Annual Meeting, Hotel Statler, Detroit, Mich.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

(For Meetings of Other Societies, see page 1081)

Junior Forum

(Continued from page 1093)

6 Execute the solution.

Each engineer may modify the problem approach to suit his own philosophy, but it is important that he identify the stages in his problem-solving procedure, and that he give explicit attention to each step. It is all too easy to treat the method of approaching a problem as one of the obvious things in life, to be taken for granted. However, every day we can see examples of problems poorly or inefficiently solved, or even worse of excellent solutions to nonexistent problems, simply because the engineer did not give careful attention to each of the steps in the problem approach. Most engineers tend to slight the early stages of problem approach for the sake of the later ones, probably because our formal education system puts much more emphasis on evaluative techniques and on the mathematical mechanics of problem solutions. However, the early stages are extremely important. Great industries, such as the automotive and appliance industries, almost exist on their ability to recognize problems involving customer needs, usually before the customer recognizes them. Once it is recognized, the problem is often simple to solve.

The area of problem definition is frequently the most critical in the entire problem approach, since accurate and precise definition of the problem may make the solution nearly obvious, or at least will simplify the remaining work greatly. There are numerous examples in the past where inadequate or erroneous problem definition has led to excellent problem solutions, except that the problem as defined was not the problem that actually existed, and the problem solving effort was in vain.

Engineers seem to be particularly reluctant to search for different methods of solving a problem. The natural tendency is to seize on the first method that comes to mind and looks fruitful, and then to pursue this method to the bitter end regardless of time, effort, or expense. It behooves the engineer to remember that there is always "more than one way to skin a cat," even in the solution of analytical problems, and that the first method thought up is not necessarily the best or most economical. Many excellent engineers will not even begin to evaluate a method of solution until they have found several alternate methods for comparison.

Engineering Attitudes. The attitude with which an engineer approaches his job and its associated problems will have a tremendous influence on his success. A few of the attitudes which he should cultivate are a positive outlook, an open mind, constructive discontent, and self-confidence in his own ability.

For some reason we live in a highly conservative world where the first reaction to a new idea is inevitably, "What's wrong with it?" or "Why won't it work?." If he is ever to make substantial creative contributions the engineer must learn to approach new ideas positively, with the attitude of "What can I do with this to make it work?" or "What is good about this idea that I can use in another way?" Closely associated with the positive approach is the attitude of the open mind, or willingness to give new ideas adequate consideration and a fair try. If Fulton, Edison, and the Wright brothers had listened to others' opinions of their great inventions, we would probably not have those inventions today. The world is not much less conservative today than it was in their time. It would pay today's engineer to remember that if engineers were infallible interpreters of physical laws and effects we would need far fewer engineers—and that until we are this good we cannot afford to summarily close the door on any idea, be it proposed by ourselves or others.

In the current world and national atmosphere, it is clear that he who is not making progress is falling behind. Consequently an attitude of constructive discontent is a highly desirable attribute. The engineer must be convinced that there is always a better way, and he should take as a personal challenge the implication that any product or process has been completely optimized. A constant search for new and better products and ways of doing things is essential to our personal, business, national, and global well being.

Perhaps the most important and effective attitude that can be carried into engineering work is that of self-confidence in one's own ability. Most engineers do not realize their own potential abilities, primarily because they are afraid to commit themselves to really difficult engineering problems. Fear of failure or mistakes is probably the main deterrent to overcome. However, the young engineer should recognize mistakes as an inevitable part of problem solving. None of our truly great contributions in science or engineering were made without the benefit of learning from past mistakes.

The Challenge. Twenty years ago, many of our products of today were nonexistent. Things like atomic bombs, electronic ovens, and guided missiles existed only in science fiction or had not yet even been conceived in the mind. In the next 20 years, we can look forward to the development of many products

which we can visualize now, such as space satellites, gas-turbine automobiles, atomic powered ships and aircraft, and supersonic travel—perhaps interplanetary travel. The next 20 years will also undoubtedly see products of which we cannot even conceive at this time. One thing, however, is sure. The products of 1957 will be developed and designed by the young engineer of 1957. It is the responsibility of each of us to prepare himself to rise to this challenge.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, Sept. 6, 1957

A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers was held in the rooms of the Society on Sept. 6, 1957. William F. Ryan, President ASME, presided. Also present were: F. L. Bradley, C. E. Crede, A. C. Pasini, and V. Weaver Smith, of the Committee; J. N. Landis, president-nominee; R. B. Lea and Joseph Pope, directors; J. L. Kopf, treasurer; E. J. Kates, assistant treasurer; E. G. Bailey, past-president; George M. Muschamp, chairman, Organization Committee; T. A. Marshall, Jr., D. C. A. Bosworth and W. E. Reaser, assistant secretaries; and Ernest Hartford, consultant.

The following actions taken by the Executive Committee are of general interest.

Dues of Members in Foreign Countries. The policy of the Society in respect to dues of members in foreign countries, which has been in effect since Nov. 25, 1945, was extended for another year.

Solar Energy Exhibit. Upon recommendation of the Board on Technology the Executive Committee, by letter ballot, authorized co-sponsorship in a solar-energy exhibit at the International Trade Fair in Salonika, Greece, Sept. 1-28, 1957, with the understanding that no cost to the Society is involved. The exhibit was prepared by John I. Yellott, chairman, ASME Solar Energy Application Committee, at the request of the Department of Commerce as a part of the United States exhibits at the International Trade Fair and is being sponsored by the Association for Applied Solar Energy, of which Mr. Yellott is executive director.

Research Committee on Random Vibration. On recommendation of the Applied Mechanics Division, Research Executive Committee, Board on Technology, and the Organization Committee, establishment was approved of an ASME Research Committee on Random Vibration to make a theoretical and fundamental study of the field of random vibration, and to express the results of such research in a form which can be understood and applied by mechanical engineers versed in the field of applied mechanics. A custodian fund for the new committee was established in accordance with the Policy on Custodian Funds.

Custodian Funds. Approval was voted of establishment of custodian funds, in accordance with the Policy on Custodian Funds, for the Nuclear Engineering Division, for research projects on flow of bulk materials and on prevention of fracture in metals, for Standardization Committee B31 on Code for Pressure Piping, and for the Wood Industries Division.

American Rocket Society. Members of the American Rocket Society were granted the privilege of purchasing at a discount of 20 per cent less than nonmember rate those publications of ASME which are sold to ASME members at a discount and to purchase ASME technical papers at the member rate, provided orders are placed by and the billings made to the American Rocket Society, and provided a reciprocal arrangement is adopted by ARS.

It was reported that the American Rocket Society has designated Robert Youngquist, Mem. ASME, as their member on the ASME Board on Technology. E. W. Jacobson was appointed by the Executive Committee of the ASME Council as representative of the ASME Council on the Executive Committee of the American Rocket Society, without vote. (See MECHANICAL ENGINEERING, August, 1957, p. 820.)

International Conference on Rubber, 1959. The Secretary was authorized to execute a memorandum of agreement for the International Conference on Rubber 1959, in Washington, D. C., to be sponsored jointly by the Division of Rubber Chemistry of the American Chemical Society, Committee D-11 of the American Society for Testing Materials, and the Rubber and Plastics Division, ASME, with the understanding that the Conference will be self-supporting.

Translation of Book on Water Hammer. On recommendation of the Board on Honors, translation of a book, "Water Hammer," by Louis Bergeron, was approved. The cost of the translation will be borne by the Freeman Fund.

Furnace Performance Factors. Extension to Dec. 31, 1957, was reported of a co-operative agreement with the Bureau of Mines, U. S. Department of Interior, for research on the computation of adiabatic temperatures of pulverized coal flames and the correlation of furnace performance on the basis of these computations. The ASME has contributed $2400 to this project through its Research Committee on Furnace Performance Factors.

Group Insurance. On Aug. 9, 1957, President Ryan appointed a committee consisting of E. J. Kates, chairman, V. Weaver Smith, and G. B. Warren to investigate a suitable group disability and hospitalization insurance plan to cover the membership of ASME on an individual optional basis for presentation to the membership.

Universities Change Names. It was noted that the name of the Colorado Agricultural and Mechanical College has been changed to Colorado State University, and that the name of the Oklahoma Agricultural and Mechanical College has been changed to Oklahoma State University.

ECPD Report. The formal report of the ASME representatives on Engineers' Council for Professional Development for presentation at the ECPD Annual Meeting, New York, N. Y., Oct. 24-25, 1957, was approved.

Personnel Service. William E. Reaser, assistant secretary, ASME, was appointed ASME representative on the Engineering Societies Personnel Service, Inc., to replace C. E. Davies.

Awards. On recommendation of the Board on Honors, the Executive Committee of the ASME Council approved the following awards for 1957:

Pi Tau Sigma Gold Medal Award to Patrick Hill McDonald, Jr., Assoc. Mem. ASME, research associate professor of mechanical engineering, Engineering Department, North Carolina State College, Raleigh, N. C., "for outstanding achievement in mechanical engineering within ten years after graduation."

Blackall Machine Tool and Gage Award to B. T. Chao, nonmember, and Kenneth James Trigger, Mem. ASME, both professors of mechanical engineering, University of Illinois, Urbana, Ill., for their paper, "Temperature Distribution at Tool-Chip and Tool-Work Interface in Cutting Metal."

Arthur L. Williston Medal and Award to Walter Franz Logeman, Assoc. Mem., trainee, Newark District, Linde Company Division, Union Carbide Corporation, Newark, N. J., for his paper, "Fostering a Spirit of Civic Service in an Engineering Curriculum."

Charles T. Main Award to Joseph F. Hunter, Assoc. Mem., structural engi-

neer, North American Aviation, Columbus, Ohio, for his paper, "A Critical Analysis of Student Sections of the National Engineering Societies."

Undergraduate Student Award to William Andrew Olsen, Jr., Assoc. Mem., design engineer, Sikorsky Aircraft Division, United Aircraft Corp., Bridgeport, Conn., for his paper, "A Visual Study of Two-Dimensional Manifold Flow Mechanics."

Old Guard Prize to George Marvin Reynolds, Student Member, Milwaukee, Wis. (Northwestern University), for his paper, "Computer Control of Machine Tools."

The topic, "Student Development of Professional Attitudes and Ethics," was approved for the 1958 Charles T. Main Award.

Joint Awards. The following joint awards were noted:

John Fritz Medal, to John Robert Suman, New York, N. Y.

Guggenheim Medal, to Arthur Emmons Raymond, Santa Monica, Calif.

Hoover Medal, to Scott Turner, New York, N. Y.

Elmer A. Sperry Medal, to H. L. Hamilton, Los Altos, Calif.; Richard M. Dillworth, Hinsdale, Ill.; and Eugene W. Kettering, Hinsdale, Ill., and their associates.

Appointments. Harold A. Johnson, Berkeley, Calif., was appointed Honorary Vice-President to represent ASME at the Sixtieth Anniversary celebration of The Japan Society of Mechanical Engineers, Tokyo, Oct. 12, 1957.

The following Presidential appointments were noted:

Tellers of Election of 1958 Officers: W. H. Larkin, J. H. Lawrence, and T. R. Olive.

Institute of the Aeronautical Sciences, National Naval Aviation Meeting dinner, Aug. 5, 1957, J. Calvin Brown.

Certificates of Awards. A certificate of award was voted to John E. Lovely for outstanding leadership in the development of codes and standards.

Certificates were also awarded to the following retiring chairmen of Sections and Subsections:

Arthur F. Weber, Jr., Akron, Ohio; Kalman Steiner, Baltimore, Md.; Francis R. O'Brien, Birmingham, Ala.; Dexter E. Fearing, Chattanooga, Tenn.; James M. Fiske, Florida; E. M. Williams, Greenville; Gordon R. Hahn, Metropolitan; Henry W. Page, Miami; J. Dillard Jacobs, Nashville Subsection; Bernard A. Niemeier, Richmond Area Subsection; and R. M. Donaldson, Virginia.

Resolution of Appreciation. On June 21, 1957, President Ryan installed the new officers of the Hawaii Section and, among other ceremonies, the following Resolution of Appreciation to the Section was adopted by the members of the Executive Committee who were in attendance:

"On behalf of the Council and the entire membership of The American Society of Mechanical Engineers, the Executive Committee of the Council acknowledges with deep gratitude and sincere appreciation the hospitality and courtesy extended by the Hawaiian Section to members of the Society, members of the Woman's Auxiliary, and their guests, during their stay in Hawaii in June, 1957."

Actions of ASME Executive Committee

At a Meeting at Headquarters, Oct. 4, 1957

A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers was held at Society Headquarters, New York, N. Y., on Oct. 4, 1957. There were present: William F. Ryan, president and chairman of the Committee; F. L. Bradley, A. C. Pasini, V. Weaver Smith of the Executive Committee; Joseph Pope and Harold C. R. Carlson, directors; William H. Byrne, vice-president Region II; E. G. Bailey, past-president; J. L. Kopf, treasurer, and E. J. Kates, assistant treasurer; C. E. Davies, secretary; O. B. Schier, 2nd, deputy secretary; D. C. A. Bosworth, T. A. Marshall, Jr., and W. E. Reaser, assistant secretaries, and Ernest Hartford, consultant.

The following actions are of general interest:

Richard's Memorial Award. On recommendation of the Board on Honors it was voted to confer the Richard's Memorial Award for 1957 on Wayne C. Edmister, nonmember ASME, research engineer, California Research Corporation, Richmond, Calif. This award was established in 1938 by Pi Tau Sigma. It consists of a cash award and an engraved certificate and is granted to a mechanical engineer for outstanding achievement in mechanical engineering within 20 to 25 years after graduation.

Roy V. Wright Lecturer. The Roy V. Wright Lecture scheduled for 1957 ASME Annual Meeting will be delivered by Governor Joseph B. Johnson of Vermont on "Engineers and Scientists in Civic, Public, and Political Life."

Topic for Annual Meeting. On Sunday evening, Dec. 1, 1957, at 8:00 p.m., Hotel Statler, New York, N. Y., the customary gathering of members of the Council, Boards, and Committees will be devoted to a discussion, of "Strengthening the ASME Programs in Research and Standardization." Members of the Society are urged to be present and take part in this discussion.

1957 RDC Recommendations. The Committee adopted statements and actions on recommendations of the 1957 Regional Delegates Conference, submitted to the Council at the Semi-Annual Meeting, San Francisco, Calif., June 10, 1957.

Certificates of Award. Certificates of award were granted to W. W. Gilbert and W. C. Beatty, retiring chairmen of the Detroit and the Canton-Alliance-Massillon Sections, respectively, also J. C. Willsey, Fort Wayne; and L. F. Deming, Washington, D. C. Certificates of Award were granted to the following chairmen of ASME Professional Divisions: Applied Mechanics, Miklos Hetenyi; Aviation, F. T. Harrington; Fuels, E. C. Miller; Gas Turbine Power, F. L. Schwartz; Heat Transfer, G. M. Dusinberre; Hydraulic, H. L. Ross; Instruments and Regulators, J. A. Hrones; Lubrication, O. C. Bridgeman; Machine Design, G. F. Habach; Management, F. W. Hornbruch, Jr.; Materials Handling, Jervis C. Webb; Metals Engineering, J. O. Smith; Nuclear Engineering, B. R. Prentice; Power, Herbert Estrada; Process Industries, J. B. Chamberlain; Production Engineering, H. S. Sizer; Railroad, F. K. Mitchell; Rubber and Plastics, F. J. Wehmer; Textile Engineering, H. W. Ball; Wood Industries, L. A. Patronsky.

Appointment. It was announced that the President appointed James H. Sams to attend the annual meeting, October 31 to November 2, 1957, of the National Council of State Boards of Engineering Examiners.

Research Agreement. On recommendation of the Research Committee approval was voted of an agreement for the Battelle Memorial Institute to conduct a one-year investigation on Corrosion and Deposits from Combustion Gases under auspices of the ASME Research Committee on Corrosion and Deposits from Combustion Gases.

American Power Conference. On the recommendation of the Board on Technology, as a result of negotiations with officers of the American Power Conference, a plan was approved for more active participation of ASME (and AIEE), at the National level, in the American Power Conference. The plan provides that a representative from the National

office of the Society shall serve as the Society's National Representative, that the Local Section be represented by its chairman, and that one or more Society representatives serve on the program committee.

Engineering Societies Personnel Service, Inc. (Agency)

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago
8 West 40th St.	84 East Randolph St.
Detroit	**San Francisco**
100 Farnsworth Ave.	57 Post St.

Men Available[1]

Production-Sales Co-ordinator, BSME; 28; three years sales engineering; three years production trouble shooting, product design, methods analysis, equipment justification, departmental co-ordination, materials handling all as a part of an integrated program; sales service. Prefers East, Midwest, Northwest. ME-446.

Engineering Manager, BSME; 35; ten years' diversified engineering management experience co-ordinated weapon systems projects, directed technical planning, supervised financial analysis and contractual performance, supervised project managers. Prefers northeast U. S. ME-447.

Mechanical Engineer, BSME; 31; six years' experience in wind-tunnel design, plant design, and administrations. Familiar with large compressor drive system, cooling systems, instrumentations. Supervised small groups. Interest not limited to wind-tunnel work. Prefers Northeast quarter of U. S. ME-448.

Production Engineer, BSME; 29; two years' machine-shop production engineering, three years heavy construction and plant layout of steam-electric power plants. Prefers New York metropolitan area. ME-449.

Mechanical Project Engineer, BME; 32; eight years field engineering and two years' test and development experience in diesel-electric field. Familiar with application, development, and maintenance of engines, auxiliary systems, mechanical and electrical drives, and controls. Anywhere in continental U. S. ME-450-9356-Detroit.

Chief Engineer, equivalent BSME; 34; 17 years in the metal-working industry in design and building of special production machinery. Main interest for last eight years die casting of aluminum, zinc, lead, and brass. Prefers Detroit area. ME-451-9362-Detroit.

Sales Engineer or Manager, BIE; 37; ten years in power plant field including seven years selling high-pressure boilers and related equipment in southwestern Michigan and western Ohio. Eighteen months in materials-handling field, with overhead conveyers and towveyers. Will relocate. Prefers Detroit area. ME-452-Detroit.

Plant Management, BSChE; 41; 14 years' experience in management problems in engineering, maintenance, and power. Good experience in economic and organizational studies, plant layout, design, and operation. Fine cost as power superintendent. Prefers Midwest. ME-453-Detroit.

Administration Engineer, BSME; 38; registered. Broad experience in design, industrial and power plant engineering, and maintenance including plywood, lumber, and woodworking and metalworking fields. Prefers West Coast. ME-454-490-San Francisco.

[1] All men listed hold some form of ASME membership.

Fuel Engineer, BSME; 55; over 30 years' experience in coal utilization. Ten years with fuel and power consulting engineers in charge of all field investigations and report writing. Twenty years with large coal producer as fuel engineer. Prefers East; will relocate. ME-455.

Creative Engineer Dynamic Management Material, 28, BME, MSE, Business. Four years refinery planning, design, development; two years testing motorized equipment; one year each, part-time teaching and technical writing. Presently supervisory. ME-456.

Engineering Management, MS, 51; 12 years in engineering management and consulting in chemical and nuclear aircraft gas-turbine propulsion including major technical and management responsibilities in research, development, and design. Also instructing in mechanical engineering. Location open. ME-458.

Vice-President, Manufacturing, or General Manager, BSME; 41; 16 years' diversified manufacturing and consulting experience including top level management for both single and multi-plant operations. Experience includes sheet metal fabrication, machining, and assembly process. Location open. ME-459.

Engineer Executive, BS; 54. Registered engineer; seeks challenging managerial position. Management of construction programs, building, maintenance, plant engineer, real estate, management, industrial-piping background. Extensive training and experience in management. Available March, 1958. Prefers South. ME-460.

Liaison Engineer, BSME; 32; single; five years aviation industry R.D. field service. Seeks responsible position as engineering representative (liaison, field service, sales) with company of international scope. Fluent German. Will relocate, travel. Prefers U. S. or Europe. ME-461.

Engineer or Instructor, BSME; 21; June, 1957, graduate of the Cooper Union. Two months' experience in jet aircraft, testing, and turbojet cycle analysis. N. Y. or L. I. area. ME-462.

Plant or Production Manager, BSME, MS production management; 32; ten years plant, production, and engineering management; success with A-1 U. S. manufacturer. Desires to prove ability in a new environment. Prefers North America. ME-463.

Chief Engineer, BSME, MS equivalent in ChE; 49; 25 years chief engineer and technical director, including design, construction, maintenance, power, development, quality control, customer liaison. Pulp, paper, similar industries. Registered. ME-464-9301-Detroit.

Works Manager, BSME; 39; six years' experience in production and manufacturing as engineering manager, works manager, general manager; five years in research. Licensed PME, Pa. Prefers northern half U. S. ME-465.

Plant Engineer—Construction, BSME; 52; engineering executive, managing capacity, 29 years' experience in all phases of plant engineering and construction; excellent health; relocation no problem. Prefers U. S., except New York metropolitan area. ME-466-835-Chicago.

Development and Research, BSME; 27; five years' engineering experience; one and a half years project engineering, schedule, specifications, test, liaison on ordnance components; two years application engineer, air and temperatures, contact with client and engineering; one and a half years' test, installations, assembly, repair of mechanical equipment. Prefers northern U. S. ME-467-553-San Francisco.

Positions Available

Research and Development Engineer, mechanical graduate, two to five years' product research and development experience on small mechanical parts in ferrous and nonferrous fields. $7200-$8400. Conn. W-5348.

Department Head, newly created department of mechanical engineering, preferably PhD but will consider an MS in mechanical engineering. Must have both industrial and educational experience. $8000-$9500. West. W-5391S.

Works Manager, manufacturer of heavy stampings, 38-47, engineering or business administration degree, background of general administration in metalworking industry, to take charge of operating two plants, taking over purchasing, engineering, and sales. Company operates two well-equipped plants with presses up to 850 tons and with auxiliary equipment for welding, rust-proofing, and finishing. Medium five figure bracket salary, plus profit-sharing bonus, fringe benefits. Midwest. W-5400.

Design Engineers, experienced in the selection and design of heat transfer equipment for a manufacturer of tubular heat exchangers for oil refineries, chemical plants, and steam power plants; particularly active in the boiler feedwater heater, evaporator, and surface-condenser field. Salaries open. Pa. W-5405.

Engineer, 26-31, mechanical or chemical engineering degree, graduate work desirable; three to six years' experience in the oil or chemical industry. Experience in the field of either project engineering, process design, or process and operations trouble-shooting, should be generally familiar with the design, construction, and operation of oil refinery or chemical plant units. Start, $7500. New York, N. Y. W-5410.

Production Superintendent, 30-45, preferably college degree; ME degree not essential but should have high mechanical aptitudes, to co-ordinate all operations and supervise approximately 30 employees on night shift of a plant which extrudes and laminates plastics. Knowledge of, or experience in, the plastics field desirable but not essential. Prefer man with some experience in supervision of others in an industrial situation. Job will require working "on the floor." Start, $6000-$7200. N. Y. suburban area. W-5411.

Director of Research and Engineering Departments, 35 or over, extensive experience in the steam power plant field. Good background in the design of steam power plant equipment and the administrative and managerial ability to give effective direction to engineering activities desired. Particularly important responsibility will involve spearheading research and development of new products. $12,000-$13,000. Eastern Pa. W-5414.

Industrial Engineer, over 45, management, industrial engineering, and production experience to make surveys, analyze operating conditions, and prepare reports covering basic industries. $15,600-$18,000. Far East. F-5422.

Product Engineer, mechanical or electrical graduate, at least five years' design, development, and product engineering experience covering mechanical aspects of electric drills, screw drivers, sanders, etc. $8000-$10,000. Company pays placement fee. Ohio. W-5423.

Plant Superintendent, engineering or industrial-management degree preferred, experience on executive administrative level in the plastic insulated wire and cable manufacturing field. Will be responsible for all manufacturing, shipping, and receiving operations. Will direct activities of traffic manager, production manager, etc. Start $8000-$10,000. New England. W-5430(b).

Director, Research and Development, to 48, advanced degrees in mechanical engineering or metallurgy, special knowledge in some of the following fields: thermodynamics, nuclear physics, power plant design, marine engineering. Experience should include some years of high level

responsibility in direction of engineers and scientists in research in afore-mentioned activities. $20,000–$25,000, depending on background, experience, and executive capacity. New York, N. Y. W-5431.

Manufacturing Executive, to about 48, graduate mechanical, preferably advanced degree, experience up through shops to top-executive responsibility, for engineering and production in such fields as shipbuilding, railroad equipment, heavy trucks and tanks, heavy ordnance, and heavy machinery. $35,000. Headquarters, New York; but must be willing to spend adequate time among plants in several states. W-5432.

Industrial Advertising Assistant Manager, to about 40, either ME, plus advertising training, or BA, plus some technical training, for large manufacturer of heavy prime equipment. Experience should include basic knowledge of graphic arts, knowledge of technical media, preparation of manuals and sales literature, etc. $12,000–$14,000. New York, N. Y. W-5434.

Operations Research Engineer, BSME, BSIE, including statistics, three years' experience in the techniques of operations research; five years' industrial engineering experience in standards, production control, methods, industrial statistics, and linear programming. Will develop scientific operating practices, apply techniques to manufacturing operations, develop and apply work sampling methods, etc. $7600–$9700. Midwest. W-5436.

Engineers. *(a)* Power station superintendent, 40–55, mechanical or electrical graduate, minimum of 20 years' experience for central station supervision, operation, and maintenance. Independent utility located central south. Lead administration of modern, large steam-electric generation station. Salary open; excellent benefit program. *(b)* Assistant station superintendent, 37–48, mechanical or electrical graduate, minimum of 12 years' experience in central station supervision, operation, and maintenance. Administrative ability and experience required to assume responsibility under direction of superintendent. Independent utility location central south. Salary open; excellent company benefit program. *(c)* Operating engineers, 32–45, mechanical or electrical graduate or equivalent, ability to test and start new steam power stations or special projects. Experience must include high-pressure steam-generating equipment. Marine experience not suitable. Salary open; liberal employee benefit program. Central south. W-5438.

Plant Engineer, at least five years' installation and operating experience covering large air-conditioning and refrigeration equipment and controls. $10,000. Midwest. W-5444.

Manager, client and professional relations, business administration or engineering degree, at least five years' office-management experience including public relations with consulting engineering firm or large construction organization. $9000–$11,000. Calif. W-5445S.

Mechanical Equipment-Specification Engineer, graduate mechanical, two to three years' special experience in selecting and writing specifications for petroleum heaters or furnaces, minimum of five years' additional experience in allied fields of mechanical equipment, for selecting and writing specifications for petroleum heaters or furnaces. $9000. Western Pa. W-5456.

Mechanical Design Engineer, for general mechanical design such as gearings, bearings, clutches, shafting, and mechanisms; minimum of three years designing of mechanical equipment, mechanics, and machinery. $8100. Western Pa. W-5457*(a)*.

Instructor, Mechanical-Engineering Department, to handle machine design as well as courses in heat. Master's degree required, registered PE and experience. Possibility of becoming head of mechanical-engineering department. To $6800, depending upon experience and rank, for nine months. Midwest. W-5458.

Senior Engineer, Development Department, graduate chemical or mechanical, over ten years' experience and capable of analyzing a project, calculating experimental test facilities, engineering design and construction of test facilities on problems involving heat transfer, gas to liquid contact, understanding of control systems, etc. Must be strong in chemical-engineering thermodynamics, fluid flow, heat and mass transfer, vapor-liquid equilibria of multicomponent systems, etc. $9600–$12,000. Pa. W-5460.

Engineers. *(a)* Engineering analyst, MS (ME), about five years' experience. Should have a working knowledge of applied math and the basic sciences and preferably some digital computer experience. $8000–$8500. *(b)* Engineering mathematician, at least BS in math and some IBM 650-computer programming experience on scientific and engineering calculations. $7000–$7500. Western N. J. W-5463.

Project Engineer, mechanical graduate, at least five years' design, development, and project-engineering experience covering complex mechanisms and electromechanical devices. $8000–$10,000. Vicinity, Boston, Mass. W-5466.

Project Engineer, graduate mechanical, minimum of five years' mechanical engineering experience in project plant engineering. Capable of handling basic designs, installation of piping, heating, air conditioning, electric circuits, and structures for company manufacturing extruded rubber products. $9000. Mass. W-5469.

Design Engineer, graduate mechanical, from eight to ten years' experience on the mechanical design of movable bridges of all types. Should know motion and stress analysis; experience in heavy machinery would be acceptable. $8000–$9000. New York, N. Y. W-5479.

Assistant Power Superintendent, about 30, graduate engineer, some experience in construction, operation, or maintenance of power equipment for pulp and paper industry. Salary open. Pa. W-5482.

Plant Manager, 40–50, mechanical engineering training, at least ten years' supervisory experience in job-shop precision-specialty fields covering tooling, production, estimating, product, and sales-application engineering. $12,000–$15,000, plus. N. J. W-5483.

Engineers. *(a)* Plant industrial engineers, to develop and administer the plant's programs for the control and reduction of elements of plant manufacturing cost. $6000–$10,560. *(b)* Chief wage-incentive administrator to establish and administer wage-incentive programs for all manufacturing operations. $6000–$10,560. *(c)* Project engineers, production-engineering division, all-round mechanical background of experience on automatic and semi-automatic machinery used for volume production of a precision article. Rate range open. Pa. W-5485.

Chief Engineer, 40–45, mechanical graduate, at least five years' supervisory product-design experience covering high-speed stampings, pressure-die castings, metal fabrication, and assembly of hardware and similar items. $12,000–$15,000. N. J. W-5488.

Engineers. *(a)* Project manager. North Africa. *(b)* Assistant project manager. Turkey. Applicants should have following qualifications: Degree and registration in architectural, civil, mechanical, or electrical engineering; five or more years specialized engineering or architectural planning; and five or more years' managerial experience in architecture or engineering; thorough knowledge of economical construction methods; complete familiarity with all phases of engineering and management; complete familiarity with U. S. Air Force construction programs and methods, etc. Salaries open. At least a one-year contract. F-5494.

Director, Research and Development Department, 35–50, responsible to vice-president-engineering, for administration of a decentralized, engineering research and development department of about 120 employees, which operates in the general areas of theoretical and applied mechanics, mechanical engineering, and engineering physics. Considerable emphasis on development of complex, high-speed mechanisms, and automatic machinery as well as in specialties such as stress analysis, heat transfer, thermodynamics, and internal ballistics. Some ordnance R&D experience highly desirable. Projects range from analytical study programs through design, prototype construction, and test. Duties include long-range planning, program, promotion, and direction. To $20,000. Ill. W-5496.

Chief Engineer, ME, to 50, 15 years' experience in design, development, and supervisory work, know paper-converting machinery—packaging machinery. Will do design development, also sales contacts and survey paper-bag machinery and converting equipment. Responsible for engineering department of about eight. Small town of 2000; some travel. To $15,000. Employer will negotiate the fee. Wis. C-6472.

Project Designer, ME or ChE, to 35, five to ten years' experience on refinery, chemical, or petrochemical process plants and system designs (computing, sizing equipment selection, specifications layout) from flow chart, no board drafting. Potentiality for chemical engineer for an established medium-sized engineering and construction firm. To $9600. San Francisco. S-3166.

Candidates for Membership and Transfer in ASME

The application of each of the candidates listed below is to be voted on after Nov. 25, 1957, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and • Transfers

Alabama

• Hobbs, Kenneth W., Mobile
Rivenbark, Edwin L., Mobile

Arizona

Ferstin, Glen R., Phoenix
Hofmann, Richard D., Phoenix
• Ream, Joseph T., Jr., Phoenix

Arkansas

Coats, John G., Jr., Pine Bluff
Spargo, Stephen P., Arkadelphia

• Transfer to Member or Affiliate

Yoder, Kenneth W., North Little Rock

California

Dennis, Dwight L., Canoga Park
Ely, Robert E., San Francisco
Gegan, John B., San Francisco
Haggett, Paul E., San Jose
• Haupt, Eugene H., San Diego
Keep, Philip R., Reseda
• Krause, Robert P., San Diego
McMacken, Donald C., San Francisco
Perkins, Clarence A., Anaheim
Reynolds, William C., Stanford
• Saenger, David M., Orinda
Thomas, Jack E., La Jolla
Wasson, James R., Alameda
• Wong, Henry P., San Francisco

Colorado

Haberland, Alvin R., Denver
Millen, Charles K., Denver

Connecticut

Bahr, William T., Plantsville
Cormier, George G., Stratford
• Elmore, I. James, Southbury
Filia, George J., Trumbull
Irish, John K., Norwich
Webb, Robert H., Danbury

Delaware

• Pearson, Sidney G., Newark

District of Columbia

• Belsheim, Robert O., Washington
Willis, Benjamin F., Washington
Yu, I. Pung, Washington

Florida

Harrison, Earle L., Pensacola
Randolph, Robert E., Keystone Heights
Register, George R., Jr., Jacksonville

Georgia

Barnard, Lloyd, Jr., Atlanta
Roberts, Charles P., Atlanta

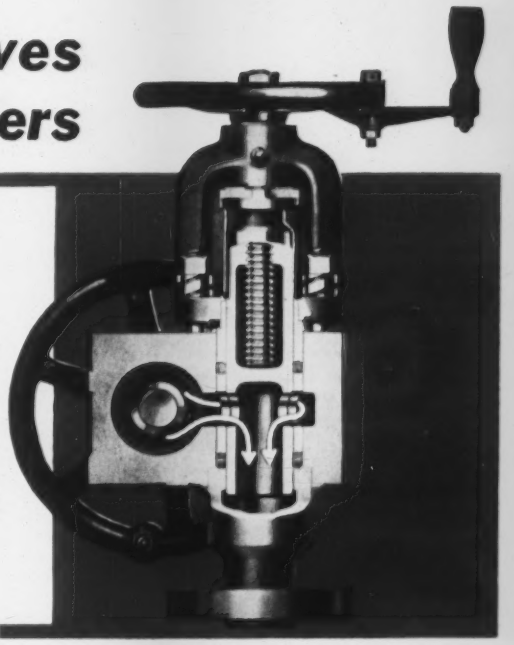
Illinois

• Baker, James E., Bloomington
Bucher, Richard F., Normal
Dunning, Ernest L., Carbondale
• Fagan, Walter, Chicago
Gundersen, Gotfred O., Chicago
Hengel, Mark F., Danville
Kindernay, James R., Chicago
Lieberman, David A., Glenview
Melton, Roger W., Waukegan
• Miller, William R., Bloomington
Muller, Charles E., Chicago
Noble, David H., Park Forest
• Palchreff, George L., Madison
Perlowski, Roy A., Orland Park
• Varshney, Mahesh C., Chicago

(ASME News continued on page 1106)

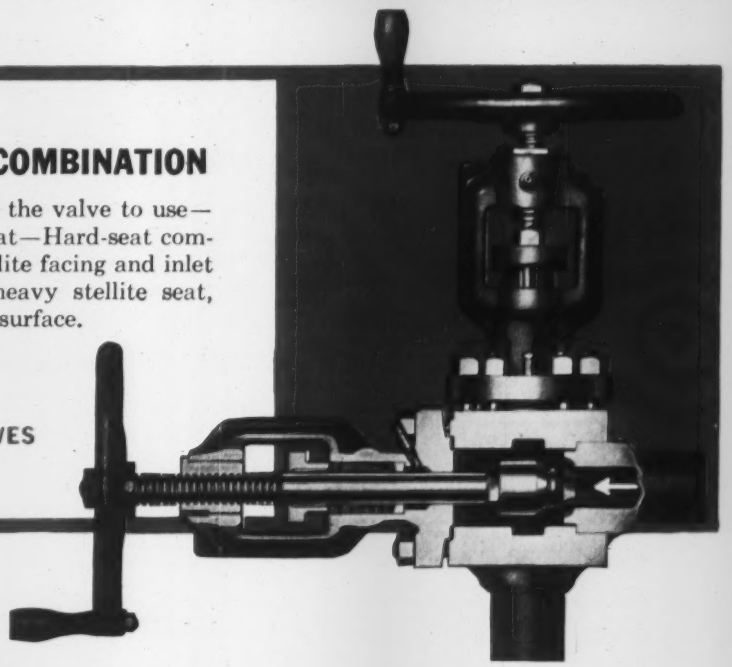
UNIT TANDEM

rugged blow-off valves for high pressure boilers



HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

OVER 4 OUT OF 5
HIGH PRESSURE PLANTS
USE YARWAY BLOW-OFF VALVES

Write for Yarway Catalog B-434

YARNALL-WARING COMPANY
108 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY **BLOW-OFF VALVES**

● Zizic, Charles P., Chicago Heights

Indiana

● Dunk, Allan C., Lafayette
Klikunas, Richard V., Fort Wayne
Young, John L., Indianapolis

Kansas

● DeCamp, Robert A., Prairie Village

Kentucky

Frey, William J., Louisville

Louisiana

Browne, John H., Jr., Monroe
Canterbury, Jack, Baton Rouge
● Robert, George W., Baton Rouge
Talmage, Robert N., New Orleans

Maryland

Bragg, Russell L., Lavale
● Malach, Kenneth W., Baltimore
Markell, John, Jr., Baltimore
Parkison, Ed H., Baltimore
Sanders, Martin, Baltimore
Sawyer, William T., Bethesda
Spitznas, Raymond J., Baltimore

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● Biwer, Lynn W., Lynn
Dearborn, Ernest B., Fitchburg
Freeman, Hollis S., Boston
McLaughlin, Edward R., Dorchester
Midtlyng, Carl R., Worcester
Scarborough, Collin W., Egypt
Schmidt, Alexander H., W. Boylston
Varga, George F., Wellesley Hills
Vargas, Ernesto F., Brookline

Michigan

Blecki, Joseph A., Detroit
Bostwick, William L., Pleasant Ridge
Churchill, Stuart W. Ann Arbor
● Siekmann, Harold J., Detroit
Wanless, James W., Detroit

Minnesota

Brandon, Dennis J., Grand Rapids
Krogh, Lester C., St. Paul

Missouri

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Pollard, H. Austin, Kansas City
Wright, Ora L., Kansas City

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● Gruetter, Werner K., Tenafly
Healey, Joseph H., Bloomfield
Margolis, David P., Newark
Reinhold, Bruce W., Trenton
Siegel, Edward J., Elizabeth
Swadba, John U., Roselle
Wigfield, Donald E., Merchantville
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Young, George E., Pennsauken

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Fitch, Theodore E., Rochester
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Kear, Edward B., Jr., Potsdam
Krause, Irvin, Bronx
McKibben, William R., No. Tonawanda
Murray, David S., Hamburg
Parisi, Charles M., Mineola
Pollack, Ephraim L., Schenectady
● Shaffer, Bernard W., New York
Smith, Allen E., New York
Snyder, Gerald R., New York
Teske, James H., Ballston Lake
● Wiesner, Frank J., Jr., Syracuse
Zimmerli, Kurt, Schenectady

Ohio

● Brewer, Edward E., Findlay
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Newton, Earl W., La Crosse
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Forbes, Douglas G., Honolulu, T. H.
Heenan, Arthur H., St. Marys, N. S. W., Australia
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Phelan, Paul F., Peterboro, Ont., Canada
Saravanamuttoo, Herbert I. H., Malton, Ont., Canada
Yates, Joseph P., Jr., Toronto, Ont., Canada

Obituaries

Raymond Baker (1890–1956), chief engineer, Horn and Hardart Baking Co., Philadelphia, Pa., died Dec. 10, 1956. Born, Conshohocken, Pa., Oct. 29, 1890. Parents, Samuel Allen and Mary Ann Baker. Education, ME, Drexel Institute, 1921. Married Anna Fleming, 1916. Mem. ASME, 1952. Held patents for automatic food and liquid dispensing machines, and automatic money collectors and changers, all assigned to Horn and Hardart. Survived by his widow; a daughter, Mrs. John R. Hamilton; and a son, Raymond Baker, Jacksonville, Fla.

Vincent Edward Bavetta (1916–1957?), whose death recently was made known to the Society, had been a design engineer, Norden-Ketay Corp., White Plains, N. Y. Born, Brooklyn, N. Y., Oct. 15, 1916. Education, ME, Pratt Institute, 1940. Assoc. Mem. ASME, 1945; Mem. ASME, 1953.

George A. Brust (1913–1957), supervisor of tool engineers, AC Spark Plug Division of General Motors Corp., died June 3, 1957. Born, Milwaukee, Wis., April 12, 1913. Parents, Angelo and Helen Brust. Education, BS, University of Wisconsin, 1938. Married Theodora Collins; three children, Victor Evon, George A., Jr., and Michael Theodore Brust. Mem. ASME, 1945. Survived by his widow and three sons.

Charles Harris Chase (1870–1957), professor emeritus, Tufts College, Medford, Mass., died July 8, 1957. Born, Stoneham, Mass., Feb. 11, 1870. Education, SB(EE), Massachusetts Institute of Technology, 1892. Married Annie C. Hatch, 1901; children, Barbara Winslow, Donald Clinton, Elizabeth Collamore. Mem. ASME, 1902. Held patents on needling machines, and designed various heating and ventilating installations. Contributed several short articles to technical magazines. Served the Society as a member and chairman of the Executive Committee of the Boston Section and for several years was honorary chairman of the Student Section at Tufts College. He served the community as a trustee and chairman of the Stoneham Public Library.

Joel Elmer Crouch (1899–1957), associate professor of industrial management, Stevens Institute of Technology, Hoboken, N. J., died Aug. 15, 1957. Born, Jacksonville, Ill., Dec. 3, 1899. Parents, Elmer Lorenzo and Mary Joella (Hawkins) Crouch. Education, BS, Illinois College, 1920; BS(CE), Yale University, 1923; MS(IE), Pennsylvania State College, 1941. Married Jessie Froude Davie, 1925; two children, Joel Elmer, Jr., and Mary Jane. Mem. ASME, 1948. Held patents among which is a navigational device. Published articles on the design, development, and construction of the icosahedral map.

Sydney Lennon Dewey (1908–1957), assistant to production engineering manager, Ryan Aeronautical Co., San Diego, Calif., died July 13, 1957. Born, Dowagiac, Mich., Oct. 13, 1908. Education, Spartan School of Aeronautics, 1930; one year of study at Princeton University. Married Allene P. Jolles, 1935. Mem. ASME, 1953. A specialist in shaping and fabrication of tubing, Mr. Dewey held six patents and was conventor of the Dewey tube-shaping process. Survived by his widow.

Johannes Peter Hansen (1894–1957), development engineer, Instrument Development Laboratory, Inc., Attleboro, Mass., died July 22, 1957. Born, Rheydt, Germany, Sept. 5, 1894. Parents, Johannes P. and Maria (Jensen) Hansen. Education, evening school for mechanical drawing and engineering. Naturalized U. S. citizen, Aug. 5, 1929. Married Regina Nydam, 1919. Mem. ASME, 1950. Survived by his widow; and two sons, Johannes P. and Reginald R. Hansen.

John Sherman Herwick (1914–1957), steam product engineer, Westinghouse Electric Corp., Cleveland, Ohio, died May 4, 1957. Born, Elwood City, Pa., June 13, 1914. Education, BS(ME), Pennsylvania State University, 1938. Mem. ASME, 1955. A specialist in steam products and gas turbines, Mr. Herwick held a patent for a spreader stoker fuel-feeding mechanism.

Arthur Arnold Lieberman (1903–1957), chief engineer, Petroleum Marketing Co., Inc., Los Angeles, Calif., died March 31, 1957. Born, Chicago, Ill., March 24, 1903. Parents, Arthur and Marie Lieberman. Education, Ogden-Davis School, 1923. Married Miss Wolfe, 1930; four children, Daryl, Donna, Dee, and Dena. Mem. ASME, 1944. Held 24 patents on emulsifiable cutting compounds and chemical-petroleum products. Licensed engineer in the State of California.

Henry Francis McNerney (1924–1957), project engineer, Construction Management Corp., New York, N. Y., died June 10, 1957 in Madrid, Spain. Born, Strabane, N. Ireland, July 19, 1924. Education, BS(ME), Technical College, Dublin University, 1941. Assoc. Mem. ASME, 1956.

Howard Henry Needham (1893–1957), manager, Atomic Equipment Section, A. O. Smith

(ASME News continued on page 1108)

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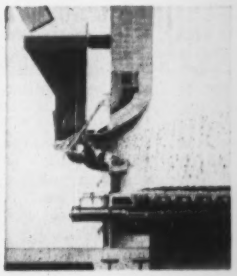

Spreader stoker with OVER-THROW ROTORS that distribute the fuel uniformly in the furnace. Fine particles burned in suspension and coarse coal, burned on the grate. Four types of grates are available. Roto-Stokers burn successfully an extremely wide range of fuels without any special preparation. In combination with coal, RotoStokers also successfully burn wood and other refuse.

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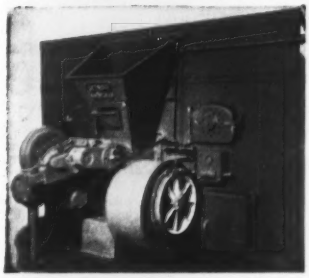


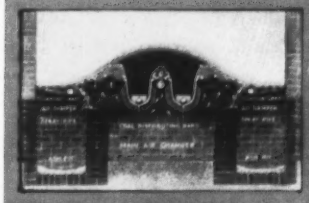
Plunger feed, side-cleaning stoker is available in various sizes for 125 to 250 horsepower boilers. Full-housed blower either motor or steam turbine driven, mounted at stoker front. Adjustable Feed provides for either manual or automatic coal feed control.

DETROIT ROTOSTOKER TYPE C-C

(Continuous Cleaning)

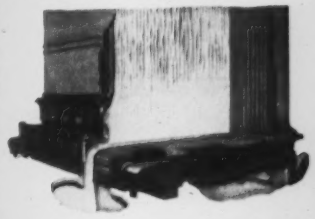
An important addition to the comprehensive "Detroit" line of spreader stokers. Readily applied to small and medium size steam generators approximately 5,000 to 75,000 pounds of steam per hour. The continuous cleaning grates automatically discharge the ash at the front for easy removal. No basement needed.

DETROIT DOUBLE RETORT STOKER



A multiple retort stoker having two retorts, with the side-cleaning feature requiring no basement. Now available with Detroit Adjustable Feed Coal Feed Control. For medium sized boilers.

DETROIT ROTOGRATE STOKER



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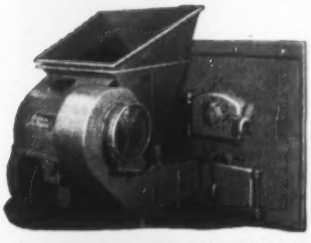

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Corp., Milwaukee, Wis., died July 13, 1957. Born, Potsdam, N. Y., Aug. 20, 1893. Parents, Fred Stevens and Zulma (Hubbard) Needham. Education, BS(CE), Clarkson College of Technology, 1916. Married Margaret Moore Sterling, 1917. Assoc. Mem. ASME, 1921; Mem. ASME, 1935. In 1945, the Army Service Force, Corps of Engineers, U. S. War Department presented Mr. Needham with a Meritorious Award for prime participation in the Manhattan District Project on the production of the atom bomb. In the same year, he received the Naval Ordnance Development Award of the Bureau of Ordnance, U. S. Navy. In 1955, Mr. Needham was appointed to the ASME Special Committee on Nuclear Power of the ASME Boiler and Pressure Vessel Code Committee. Survived by his widow; and two daughters, Mrs. Frederick Louis Ott and Suzanne Sterling Needham.

George Roscoe Ozley (1889–1957), mechanical engineer in charge of design, construction, and maintenance, Alabama By-Products Corp., Birmingham, Ala., died March, 1957. Born, Siluria, Ala., Oct. 12, 1889. Education, Alabama Polytechnic Institute, 1910. Assoc-Mem. ASME, 1928; Mem. ASME, 1934.

Lester Beresford Paterson (1890–1957), retired purchasing agent, Combustion Engineering, Inc., New York, N. Y., died July 24, 1957. Born, Westfield, N. J., Aug. 3, 1890. Parents, Mr. and Mrs. James R. Paterson. Education, ME, Stevens Institute of Technology, 1912. Jun. ASME, 1915; Assoc. Mem. ASME, 1921; Mem. ASME, 1925.

Philip Herliman Phillips (1902–1957), self-employed, New Castle, Ind., died July 9, 1957. Born, New Castle, Ind., Nov. 7, 1902. Parents, Percy Gilam and May (Herliman) Phillips. Education, BS(ME), Purdue University, 1924. Married Martha Wilson, 1928. Assoc-Mem. ASME, 1943; Mem. ASME, 1946.

Bela Zoltan Reiter (1888–1957), manager, illustrations department, McGraw-Hill Publishing Co., Inc., New York, N. Y., died June, 1957. Born, Kassa, Hungary, Aug. 8, 1888. Parents, George and Juliett (Kremla) Reiter. Education, ME, University of Budapest, 1910. Naturalized U. S. citizen, Camp Dix, 1917. Married Helen Lacay, 1918. Mem. ASME, 1929.

Hudson Roy Searing (1895–1957), chairman of the board, Consolidated Edison Company of New York, Inc., died June 26, 1957. Born, Rock Tavern, N. Y., May 3, 1895. Parents, Hudson R. and Elizabeth (Barling) Searing. Mem. ASME, 1944. Married Geraldine Kendrick, 1917; two daughters, Jean L. Hoppins and Doris K. Busch. Published several papers in technical journals and held patents issued on electrical designs. Member Tau Beta Pi. Served as a flying cadet in the U. S. Army during World War I.

Alexander Shayne (1881–1957), vice-president and director, Bulova Research and Development Laboratories, Flushing, N. Y., died July 26, 1957. Born, Baku, Russia, Aug. 31, 1881. Education, ME, Mittweida Engineering College, Germany, 1900. Assoc-Mem. ASME, 1918; Mem. ASME 1919. During World War I, Mr. Shayne along with E. A. Sperry developed the ship stabilizer. He spent 22 years with the Sperry Gyroscope Co. as chief engineer and vice-president in charge of manufacturing. During World War II, he was appointed to the War Production Board in Washington, D. C. Shortly thereafter, he became affiliated with the Bulova Watch Co., to design and establish factories for producing precision instruments for the war effort. He was chief engineer and general manager of the Fuse Division of the Bulova Watch Co. For his services as chairman of the U. S. Fuse Integration Committee, he received several federal citations. Since 1950, he had served as consulting engineer of the Bulova Research and Development Laboratories. Survived by his widow, Louise Shayne; his brother, Victor, Stamford, Conn.; and sisters, Nadine and Freda, New York, N. Y.

Harry Willis Stevenson, Jr., (1905–1957), sales engineer, Combustion Engineering, Inc., Cincinnati, Ohio, died June 18, 1957. Born, Penn Township, Allegheny County, Pa., March 13, 1905. Parents, Harry Willis and Gertie (Stacy) Stevenson. Education, Hays School of Combustion, 1930. Married Claudia Seeger, 1932. Mem. ASME, 1949. Mr. Stevenson had published articles in the technical press. Survived by his widow.

Oscar Emile Weber (1894–1957), production co-ordinator, S. Morgan Smith Co., York, Pa., died Jan. 14, 1957. Born, Arbon, Switzerland, Sept. 11, 1894. Education, Swiss Trade School, 1915. Assoc-Mem. ASME, 1929; Mem. ASME, 1935. Survived by his widow, Elsie E. Weber.

Louis James Wheeler (1895–1957), general superintendent, Lone Star Cement Corp., Dallas, Texas, died July 6, 1957. Born, Detroit, Mich., May 29, 1895. Parents, James A. and Minnie M. Wheeler. Education, ME, Kansas University, 1917. Married Willie May Gulledge, 1921. Mem. ASME, 1928. Mr. Wheeler served as a second lieutenant in the U. S. Army during World War I. He had been a management specialist interested in materials handling and the process industries.

Olle Wikstrom (1896–1957), technical director, Boras Wafveri Aktiebolag, Boras, Sweden, died July 27, 1957. Born, Kramfors, Sweden, Aug. 17, 1896. Education, Technical College, Härnösand, 1914. Mem. ASME, 1949. Mr. Wikstrom had been the author of many papers and lectures pertaining to textile technology. He had been a member of the Swedish Association of Technologists, and president of the Technical Association of Boras, Sweden.

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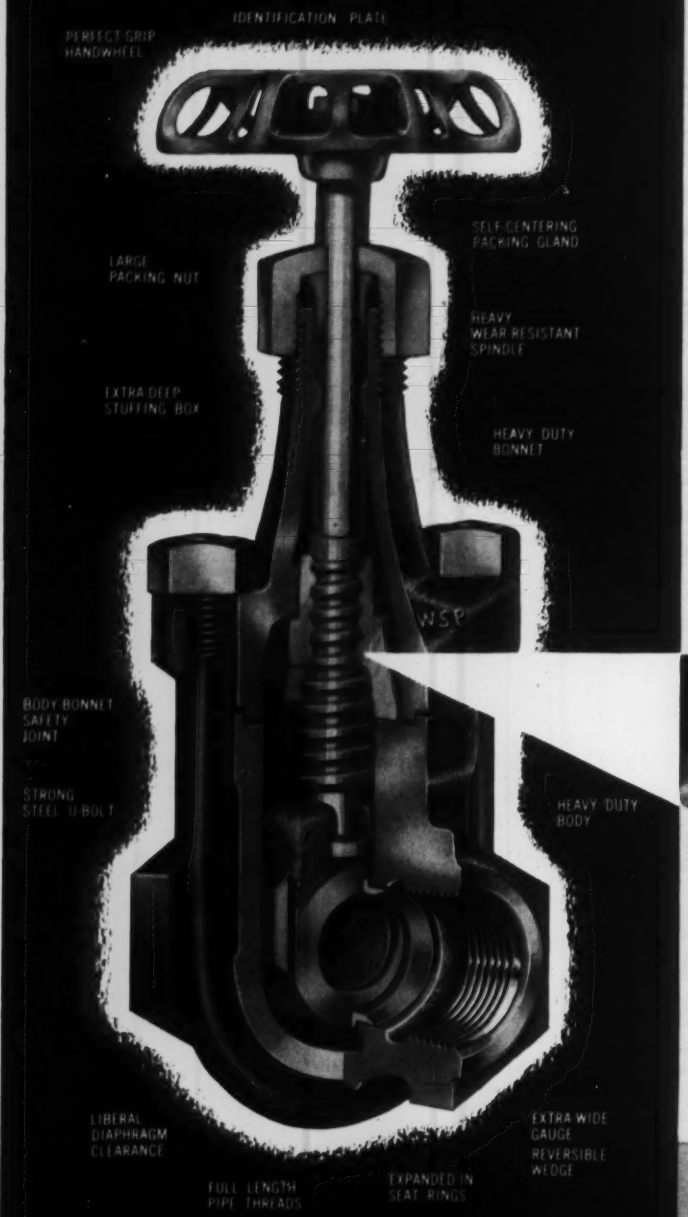

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1 TURBINE GENERATORS

Worthington Corp.—Bulletin 1960C illustrates and describes turbine generators in the 1500 to 15,000 kw range. Data on turbine types and applications, construction, testing and installations is provided in this 36-page booklet.

2 CERAMIC INSULATED WIRE

Aero Research Instrument Co.—Descriptive bulletin describes ceramic insulated wire, used for reactor thermocouple wire and leads, power leads, low-level instrument signals, and resistance elements, in high radiation fields, at high pressure, and temperatures 400 to 2000 F. Wire is available in several sheath diameters from 0.025 to 0.31 in., multiple conductors, and a variety of sheath and conductor materials.

3 SOLID, TUBULAR EXTRUSIONS

Babcock & Wilcox Co., Tubular Products Div.—Bulletin TB-413 tells of the division's tubular and solid extruded shapes, lists extrudable steels, high alloys and nonferrous metals and briefly explains the process, size ranges, dimensional tolerances and advantages of the use of extruded solid or tubular sections.

4 HIGH-STRENGTH STEELS

United States Steel Corp.—A 174-page manual discusses the essential principles of structural design and contains numerous formulas, charts and tables to assist in designing, for high-strength steels. The hard cover, ring-bound book covers engineering considerations and fundamental characteristics of high-strength steels, design considerations, working unit stresses, tension, compression, shear, stresses in beams, deformation and deflection, formed sections and designing against corrosion.

5 WELL WATER SYSTEMS

Layne & Bowler, Inc. Bulletin 100 contains case histories and application photos of well water systems, pumps, shutter screens, special drilling applications featuring vertical turbine pumps.

6 GAS TURBINE ENGINES

Solar Aircraft Co. New 24-page brochure describes the company's 500 hp Jupiter gas turbine engines. The brochure contains photos of installations, cutaway views of different engine configurations, performance charts, outline drawings. Sections describe comparative performance of gas turbine and diesel engines, principles of gas turbine power, components and accessories, and potential applications.

7 VIBRATION TEST MACHINES

All American Tool & Mfg. Co.—Bulletin 562 describes seven new models of vibration fatigue test machines equipped with new D type range selector for widely variable acceleration control. The unit is said to provide infinite frequencies from 10 to 60 cps, which are recorded on an electric tachometer. Bulletin also lists typical users, shows installations.

8 MATERIALS HANDLING EQUIPMENT

Allen-Sherman-Hoff Co. Data sheets on hydraulic and pneumatic materials handling systems and components describe and illustrate application, design and construction, operation, dimensions (for components) and typical arrangements. Engineering charts and technical data are also included.

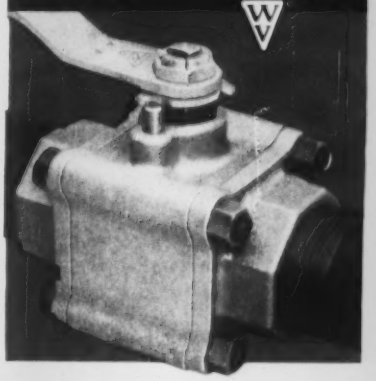
9 DIESEL ENGINES

Alco Products, Inc.—Bulletin DE-6 presents specifications, fabrication features of Model 251 diesel engines. Bulletin contains foldout with cross section and captioned illustrations of major components of 6-cylinder in-line engine and 12 and 16-cylinder Vee type engines.

10 STEEL PLATE CONSTRUCTION

Chicago Bridge & Iron Co.—Methods for high quality steel plate construction are described in a four-page brochure. The firm's field welding, field X-ray and field stress relieving techniques are discussed. Coke drums, catalytic cracking units, a 225-ft diameter Hortonsphere, reactor-regenerators, sulphite digesters and accumulators are illustrated.

Econ-O-"Miser"



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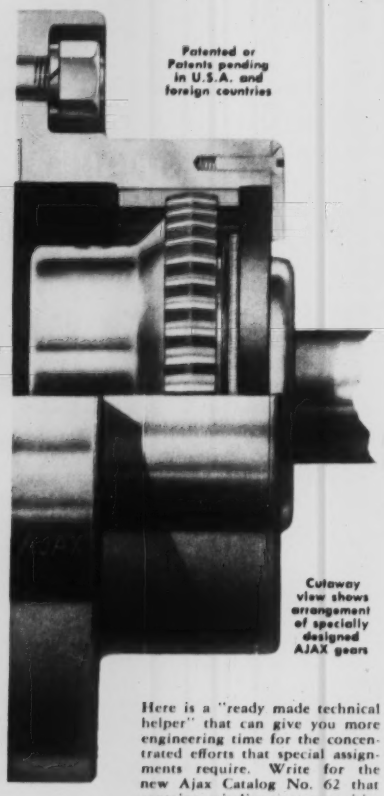

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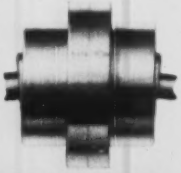

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11 VALVE-UNION

Worcester Valve Co., Inc.—Catalog WV 454 describes new Econ-O-Miser valve for positive leak-proof shutoff. It acts as both a valve and union. Comparative labor and materials costs for this valve and other types are given.

12 ELECTRIC BRAKE

Warner Electric Brake & Clutch Co.—The firm's newest electric brake designed for fail-safe applications is covered in a 36-page illustrated report. Photographs, drawings, diagrams, and explanation of operation, selection factors, torque characteristics and controls are included.

13 ROTARY ELECTRICAL UNITS

Western Gear Corp., Electric Products Div.—Bulletin 5721 contains specifications and diagrams of the firm's permanent magnet and wound field d-c motors, a-c motors with and without gear reduction, a-c/d-c generators, motor and fan assemblies, axial flow blower assemblies, centrifugal blower assemblies and voltage regulated power supplies and stroboscopes.

14 SPEED VARIATOR

Cleveland Worm & Gear Co.—Bulletin K-200 illustrates and describes a speed variator that provides indefinitely variable output speed over a range up to 9:1 from a constant speed power source. Operating characteristics, diagrams and cutaway drawings are included.

15 DATA PROCESSING

Consolidated Electrodynamics Corp.—A 32-page general catalog, No. 1305, describes recording oscillographs and amplifying systems, direct writing oscillographs, vibration pickups, pressure pickups, magnetic tape systems, analog-to-digital conversion systems, and analytical and process control instruments including mass spectrometers, chromatographs, refractometers, leak detectors and sulphur monitors.

16 BOILER SERVICE VALVES

Everlasting Valve Co.—Bulletin describes the Everlasting Quick-Opening and Slow-Opening Straightway Valves, Angle Valves, Y Valves, and Duplex Blow-Off Units, with specifications, materials of construction, and dimensions of each type. Illustrations include details of design, sectional and exploded views, and explanations of operation of the valves. A section of the bulletin also describes Everlasting Valves for fire protection.

17 SYNTHETIC RUBBER

B. F. Goodrich Chemical Co., Div. of B. F. Goodrich Co.—"Everywhere in Industry—Hycar American Rubber," 24 pages, describes Goodrich Hycar rubber and its properties, using text and tables. General applications and uses are suggested for the different types and blends available.

18 POTENTIOMETER

Norden-Ketay Corp.—Bulletin 415 gives specifications and outline drawings for sector potentiometers designed to operate in damping fluids and in temperatures in excess of 150 C. Life is rated in excess of 1,000,000 cycles, resolutions as fine as 0.0006 in.

19 GAGES

Manning, Maxwell & Moore, Inc.—A 128-page catalog describes the company's line of Duragages, quality, drawn case, chemical, chemical attachments, special application, navy and marine, laboratory and pocket test, Mercury column pressure and vacuum gages.

20 EXPANSION-JOINT DESIGN GUIDE

Flexonics Corp.—A 24-page Flexon Expansion-Joint Design Guide, Catalog 160, covers engineering application and selection data necessary to the proper solution of pipeline expansion problems. Features of the Flexon Design Guide include a discussion of the various types of expansion joints on the market, the many types of Flexon Expansion Joints available, and types of pipeline motion solved by expansion joints; also expansion joint design considerations, installation instructions, and selection data. The new line of Model H compensators is completely covered. The center spread of the catalog is devoted to a schematic piping layout illustrating various expansion joint applications and principles.

21 FORGING APPLICATIONS

Drop Forging Assn.—"Management Guide to the Use of Forgings," is an informal report planned to stimulate imagination. This six-page booklet states advantages that forgings offer to designers, metallurgists, purchasing agents and executives.

22 PENCIL SELECTOR

Eagle Pencil Co.—A booklet explains the fundamentals of pencil quality and tells how to select the proper pencil for manifold forms, legal forms, duplicating machines, checking, marking, steno use, charting graphs, blueprint marking, drafting, and general writing.

23 OIL SEALS

Chicago Rawhide Mfg. Co.—A 68-page illustrated catalog lists all oil seals carried in stock with accompanying stock and part numbers. Various materials used for the seals are described.

24 REPRODUCTION FILMS

E. I. du Pont de Nemours, Photo Products Dept.—Bulletin A-4629 covers Cronaflex, new line of reproduction materials on polyester photographic film base. Included are direct positive, contact and projection films for use in fields of engineering, drafting, blueprinting, architecture, cartography, surveying.

25 LEASE AUTOMATION SYSTEMS

Black, Sivalls & Bryson, Inc.—Packaged lease automation from wellhead to pipeline provided by the firm's new Phanto-Matic lease system, is described in a 20-page catalog. The system offers fully automatic wellhead shut-in control, well test control, well-flow control, tank switching, custody transfer, fluid metering, and lease safety controls.

26 ROTARY COMPRESSORS

Ingersoll-Rand Co.—Form 2321-B illustrates and describes the complete line of Gyro-Flo portable rotary compressors. The compressors are manufactured in six sizes, ranging from 85 to 900 cfm. Illustrations of the many jobs performed by these compressors are also shown.

27 DRAFTING MACHINES

Charles Bruning Co.—"The Finest in Drafting Machines," a 20-page illustrated booklet, explains the cost and time-saving advantages offered by drafting machines in mechanical drawing, and describes and illustrates models and construction features. A list of available scales is included.

28 ROLLER BEARINGS

Torrington Co.—New drawn cup roller bearing is described in six-page catalog. Detailed data on bearing design, installation, lubrication and load capacity are included, together with information on sizes available. Design features and typical applications are illustrated and described.

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29 TEMPERATURE REGULATOR

Fulton Sylphon Div., Robertshaw Fulton Controls Co.—Four page brochure illustrates and describes No. PA-2 self-operating temperature regulator for the metal finishing industry. Application data for plating, bonderizing, cleaning pickling and rinsing is supplied.

30 INTERFEROMETER

Link Aviation, Inc.—A leaflet is available describing the Link Fringecount micrometer which is a measuring device using the light interference principle. Measurements up to two inches are possible, with accuracy claimed of one millionth of an inch. Gage blocks, plug gages, and ball and roller bearings measured.

31 CALORIMETER

Parr Instrument Co.—Specification No. 1200 illustrates and describes Series 1200 adiabatic type oxygen calorimeter for determining thermal values of solid or liquid fuels. Principle of operation, specifications, and features of the unit are included.

32 WATER SOFTENERS

Cochrane Corp.—A 20-page publication, No. 4520, deals with the necessity for water softening, explaining the fundamentals of softening and selection of equipment and zeolites. The bulletin also describes the operation of the firm's hydromatic valve for manual or automatic control of the cycling of the process.

33 STEEL TUBING

Bundy Tubing Co.—A 12-page catalog contains technical information on physical properties, available sizes and method of manufacture of steel tubing. Also included are possible applications and methods of fabricating.

34 LOW NPSH PUMPS

Roy E. Roth Co.—An eight-page illustrated bulletin describes newly developed Low NPSH turbine pumps for heads to 1600 ft, capacities to 100 gpm, requiring 1 to 3 ft NPSH. Performance, mechanical and dimensional data are included. The pumps are specifically designed for LPG; refrigerants; chemical process handling clear, boiling liquids; boiler feed service. They are available in special metals for corrosive service.

35 UNDERGROUND CONDUIT SYSTEMS

Stillwater Clay Products Co.—A four-page brochure describes vitrified clay conduit systems. This illustrated brochure describes the revolutionary new and exclusive Cert-A-Bar tunnel and Lock-A-Bar round systems and the many features of conduits, designed to assure permanent protection for piping. Information on conduit design, installation, engineering, insulation, waterproofing specifications and fittings also is included.

36 FLUID COOLERS

Trane Co.—Bulletin S-395, eight pages, discusses features of air cooled heat exchangers to cool liquids and gases, condense vapors, covers operational features, models, range of sizes, installation versatility, component parts, and extended surface heat transfer surface construction.

37 SELF-ALIGNING COUPLINGS

Koppers Company, Inc., Metal Products Div.—A 6-page folder illustrates and describes principles and features of Fast's self-aligning couplings. A table of utility factors for various kinds of connected machines and tables of rating for standard forged-steel and heavy-duty couplings are included.

38 STOCK GEARS

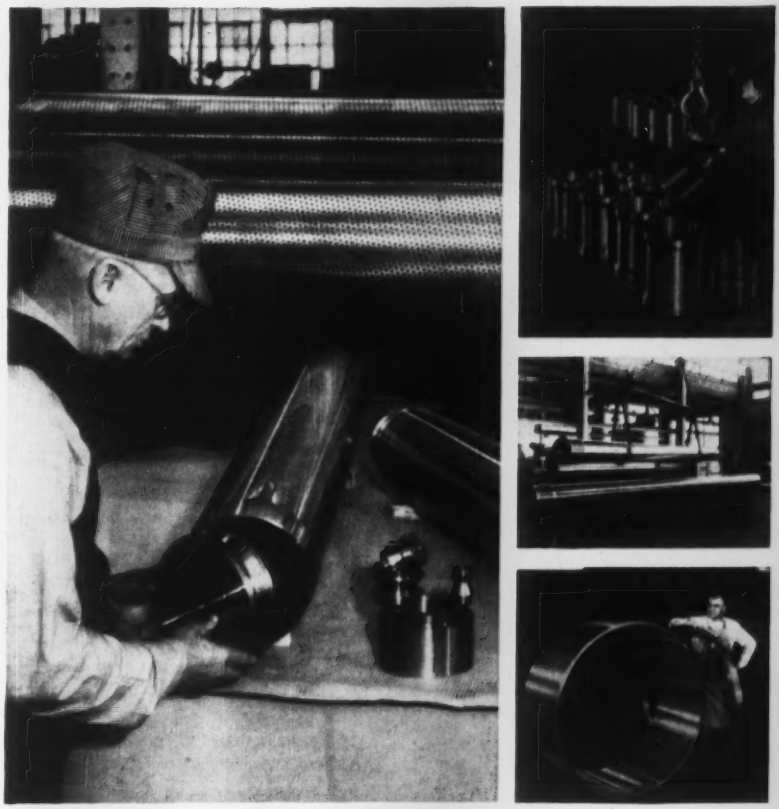
American Stock Gear, Div. of Perfection Gear Co.—Catalog No. 360 contains information and engineering data covering brass, bronze, steel, semi-steel, cast iron, and nonmetallic gears in a range of 48 to 3 diametral pitch.

39 SHELL-ICE MAKERS

Frick Co.—Bulletin 54-C covers automatic shell-ice makers in nine sizes from 2 tons. Ice is frozen in thicknesses of $\frac{1}{8}$ and $\frac{1}{2}$ in. on the outside of stainless steel tubes.

40 AUTOMATIC CONTROLS

Mercoid Corp.—Catalog Number 858, a 60-page reference book for engineers, contains information



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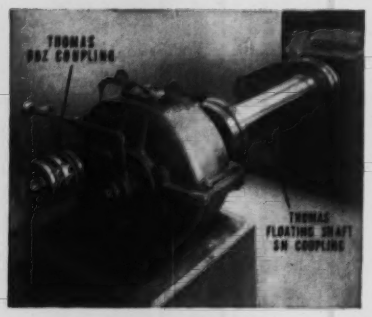

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YOUR **New Catalogs** GUIDE — LATEST INDUSTRIAL LITERATURE

on automatic controls for pressure, temperature, liquid level, and mechanical movement. Transformer-relays and mercury switches are also listed.

41 PROCESS INSTRUMENTATION

Fischer & Porter Co.—A 32-page catalog describes the company's products available for immediate shipment. Included are prices. It covers indicating, recording, controlling and transmitting instruments for flow, pressure and density.

42 TORSIONAL VIBRATION DAMPER

Houdaille Industries, Inc., Buffalo Hydraulics Div.—A brochure describes the operation and use of viscous torsional vibration dampers. It includes a data sheet required to apply this damper to internal combustion engines and rotary systems likely to have critical speeds in the operating range. The damper is untuned and said to provide highly efficient damping even when damper is not optimum for the system.

43 THREAD INSERTS

Heli-Coil Corp.—Catalog on standard line of screw thread inserts designed for protection and repair of tapped threads in all materials is contained in Bulletin 652-A. Covered are design information, drilling and tapping recommendations, and specifications for various classes of fit. Also available is Bulletin 738 which provides similar details on new screw-lock insert which eliminates the need for lock washers, lock nuts, lock wiring.

44 DEAERATION

Cochrane Corp.—Publication No. 4650 explains in capsule form the fundamentals of deaeration and why it is necessary in water conditioning. The principles of operation as well as the advantages and application of the various methods of deaeration are discussed.

45 DRAFTING DESK

General Fireproofing Co.—A folder illustrates and describes a drafting desk which has a belt positioning control and incorporates a reference area and storage space in one compact unit.

46 PLUG VALVES

DeZurik Corp.—A 36-page catalog covers eccentric plug valves. It explains eccentric action principle, and describes 1/2 through 20 in. valves and accessories, pneumatic, hydraulic and electric operators, pipe line strainers, and indicates service recommendations for valves. Valves are illustrated and dimensions are listed with flow charts.

47 MEASURING EQUIPMENT

General Electric Co.—Bulletin GEC-1016B illustrates and describes electric circuit testing equipment, oscillographs, insulation and resistance testing, magnetic field equipment, timing devices, X-ray diffraction equipment, radiation instruments, recorders, gages, and leak detectors.

48 STEAM TRAPS

Armstrong Machine Wks.—A 44-page manual on condensate drainage contains data on semi-steel and forged traps, discusses the fundamentals of good trapping, and deals with trap selection problems, installation, repair and trouble shooting.

PAST EXAMINATIONS
for Professional Engineers given by New York State

This pamphlet contains the questions given in 1952-1956 examinations. They cover problems in structural planning and design, in practical applications of basic engineering sciences, and the more advanced and specialized problems in practical applications of engineering principles and methods.

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49 SILVER BRAZING OUTLETS

Bonney Forge & Tool Wks.—Brazolets used for silver brazing outlets to copper or brass pipe or tubing are described in this bulletin. The outlet portion is brazed or screwed. This construction is said to allow rapid installation of random length mains and subsequent attachment of outlets.

50 LUBRICATION PROBLEMS

Kano Laboratories—Bulletin deals with lubrication problems, rust problems, cleaning problems and specifically with the loosening of stuck together metal parts.

51 COPPER, COPPER ALLOYS

Revere Copper & Brass Inc.—"Technical Information on Revere Copper and Copper Alloys," 48 pages, discusses the advantages, compositions, physical properties, ASTM and SAE specifications of copper and copper alloys, as well as welding techniques.

52 PIPE WRAP

Rhopac, Inc.—Literature describes a new pipe wrap which combines an under-wrap of quality glass fiber insulating material and an outer wrap of vapor sealing tape. The new wrap is said to prevent condensation and sweating of cold water pipes and provide a highly efficient insulation for hot water pipes.

53 STREAMLINED BAFFLES

Engineer Co.—Bulletin BW-54 shows the design and describes the construction of streamlined baffles for many types of water tube boilers for various furnace designs and methods of firing.

54 TANKS, VESSELS

Graver Tank & Mfg. Co., Inc.—Centennial issues of the firm's employee magazine outline case of special applications of tanks and vessels in atomic energy, steel, aluminum, oil, sugar and water supply industries.

55 MAGNETIC FRICTION CLUTCHES

Dynamatic Div., Eaton Mfg. Co.—New line of electromagnetic, friction-type, industrial clutches and brakes is described in Bulletin MF-1, which includes illustrations of the various types and combinations as well as the separately-mounted control system used with the Dyna-torQ line.

56 PRESSURE VESSELS

Koven Fabricators, Inc., Div. of L. O. Koven & Brother, Inc.—Bulletin No. 550 illustrates and describes mixers, kettles, vacuum and pressure vessels, autoclaves, evaporators, impregnators, condensers, stills, extractors, tanks, standpipes piping, stacks.

57 FUEL SYSTEMS

Foster Wheeler Corp.—New 68-page bulletin covers large central station and industrial installations of all types including reheat and dual circulation. It includes cross-sections of coal, oil and gas-fired units; descriptions of pulverized-fuel systems, burners, drum internals, reheaters, superheaters and other accessories.

58 SUMP, PROCESS PUMPS

Goulds Pumps, Inc.—Bulletin 726.2 describes a new group of vertical centrifugal pumps especially designed for sump and process work. Single and duplex units can be supplied for wet pit or dry pit construction. Single units range in capacities up to 1080 gpm and for heads up to 290 ft, for pit depths to 20 ft.

59 PHOTOELASTIC STRESS ANALYSIS

General Radio Co.—An eight-page booklet covers a lightweight polariscope having an 8-in. field. Details are given regarding static and dynamic stress measurements for both visual and photographic applications, including dynamic measurements with a high-speed light source.

60 OSCILLOSCOPES

Allen B. Du Mont Laboratories, Inc.—General instrument catalog contains specifications and operating data on oscilloscopes, pulse generators, signal generators, electronic switches, photographic recording equipment and associated accessories.

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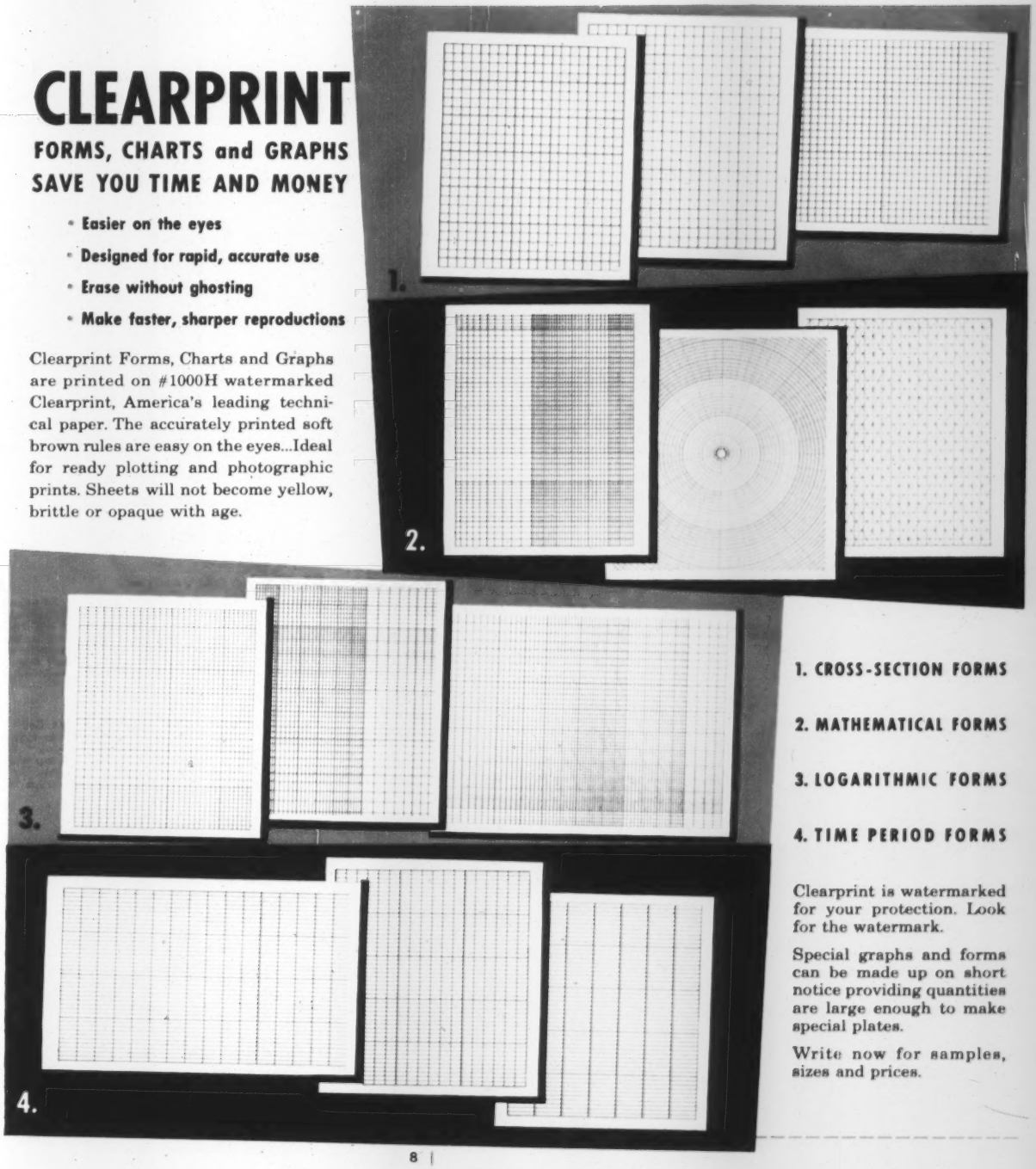

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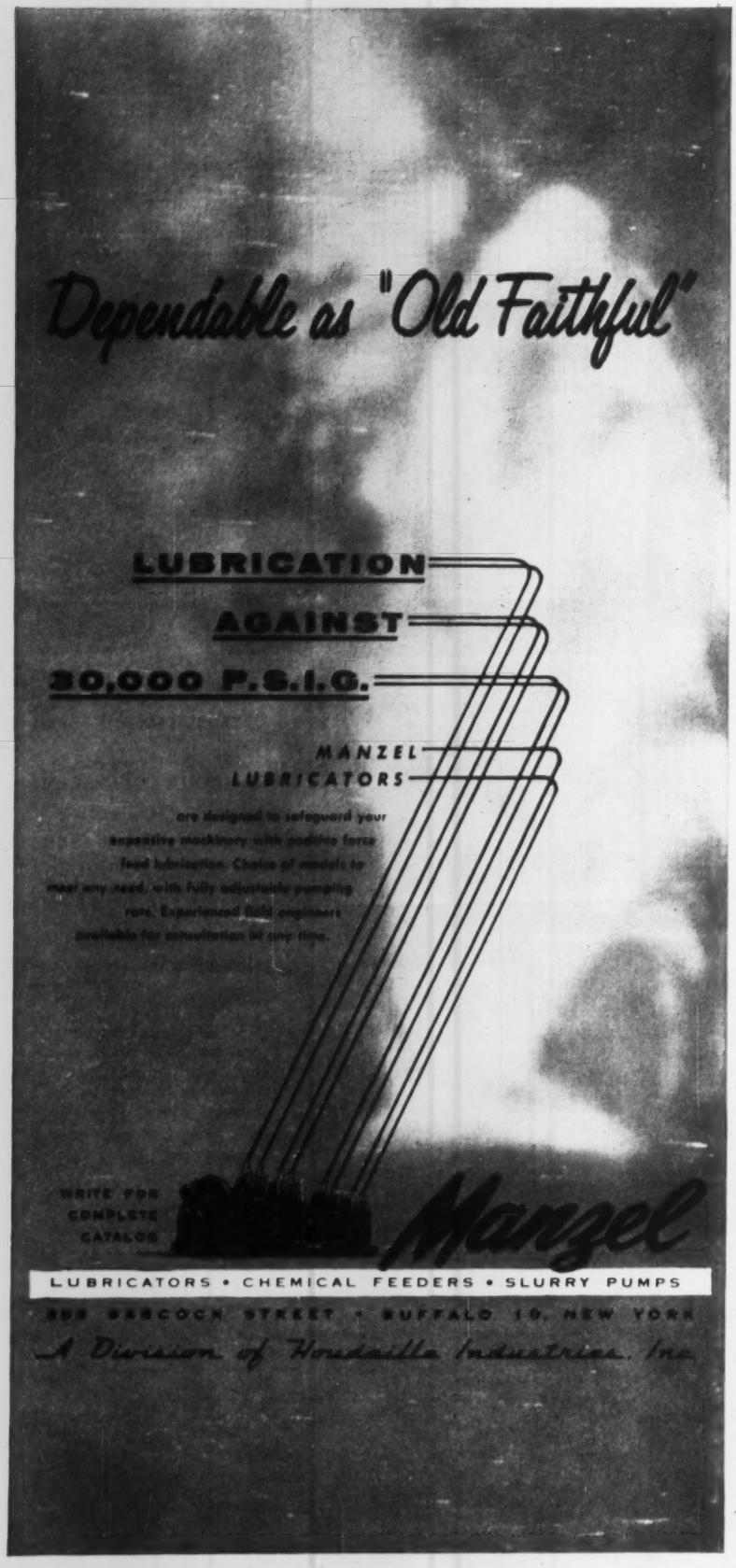
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YOUR New Catalogs GUIDE

61 BOILERS, FIRE-TUBE PACKAGE

Erie City Iron Works—Bulletin SB56 describes its FT 3-pass fire tube package boiler with data and section views. The unit is completely assembled, factory fire-tested with burner, gas, oil or combination type, with fuel selected. It is a pressurized unit said to provide precise control of excess air and CO_2.

62 DRAFTING EQUIPMENT

Chart-Pak—Catalog contains illustrations and specifications on templates, tapes for graphs, charts, pre-drawn rectangles and circles, work flow and data processing symbols, planning boards and sheets, and tapes for broken line, statistical, material conveyor, structural, straight line, arrow, border line and reference.

63 STEEL WIRE

American Chain & Cable Co., Page Steel & Wire Div.—A 16-page, DH-1226, catalog on Page shaped wire includes specification tables, range of sizes, physical properties of steel wire, table of standard wire gages, hardness conversion tables, with illustrations showing how to calculate areas of typical common shapes of wires. Size range includes cross-sectional area up to and including No. 3 BWG; flats and rectangles in widths up to $^3/_8$ in., the ratio of width of thickness not exceeding 6 to 1.

64 HOT-DIP GALVANIZING

American Hot-Dip Galvanizers Assn.—A 16-page booklet outlines rust prevention in industrial and consumer products through the use of the hot-dip galvanizing process. Included are photographs of products made by the method, and illustrations of production and quality control. Chart compares method with other types of rust prevention.

65 TURBINE PUMPS

Aurora Pump Div., New York Air Brake Co.—Current line of centrifugal and turbine-type pumps is presented in a condensed catalog. A selection guide indicates which types of pump will meet certain capacity and head demands. A bulletin guide for more detailed information is included.

66 REDUCTION EQUIPMENT

American Pulverizer Co.—Literature describes reduction problems of various processing industries. Construction and operating features, specifications are fully discussed and illustrated. Bulletins are available on coal crushers, stone crushers, metal turnings crushers, plastics granulators, wood hogs.

67 MACHINE DESIGN IDEAS

Lincoln Electric Co.—"Design Ideas" is a series of pamphlets issued periodically to design engineers, production men, and management executives. Series outline fundamentals of how to design with steel, to reduce costs and improve performance, with special charts and checking information. Case histories are presented to illustrate new ideas. Latest study discusses vibration.

68 COMBINATION OIL-GAS BURNERS

Anthony Co.—Data Sheet BG-H describes Nebulyte combination oil-gas burner, and includes capacity table, selection chart graph, dimension drawings and typical layouts of burners and accessories. Also available are Data Sheets BA, BD and BL covering low and high-range industrial oil burners and Bulletin 501 on a proportioning burner.

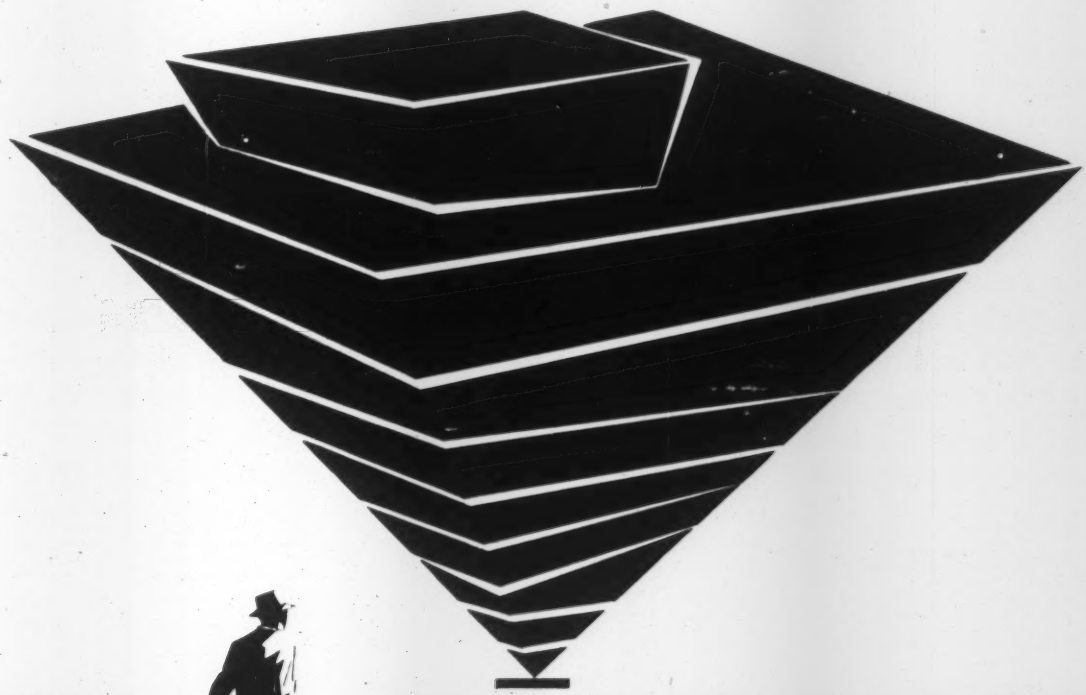
69 RUBBER MOUNTED ASSEMBLIES

Bushings, Inc.—Three catalogs illustrate and offer engineering data on rubber mounted bearings and bushings, machinery-mountings and pillow blocks.

70 PIPE COUPLER

John Bean Div., Food Machinery & Chemical Corp.—A folder illustrates and describes a fast move industrial coupler designed for use with any make of portable aluminum pipe for transporting brine, natural gas, crude oil, butane, water and other liquids for the petroleum, chemical, mining and construction industries.

Continued on Page 82



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YOUR *New Catalogs* GUIDE

71 ROLLER CHAIN, SPROCKETS

Diamond Chain Co., Inc.—Catalog 757 covers the firm's line of stock roller chains and sprockets. Data on selection, establishing service horsepower and determining size of driven sprocket is included.

72 CONVEYOR SYSTEMS

Fuller Co.—Bulletin G-3, eight pages, pictures and describes pneumatic conveying systems built by the company for handling dry, pulverized and granular materials. Diagrams showing how systems work are included. Also illustrates and describes rotary compressors and vacuum pumps, inclined-grate coolers and Humboldt preheater for handling dry, granular materials.

73 BOILER, TANK CONTROL

Commercial Shearing & Stamping Co.—Three catalogs are offered. Catalog P-2 covers products for boiler and tank manufacture; P-3, standard shapes which are available without tool and die charges; G-1, applications and advantages of stampings, forgings and assembled products.

74 STAINLESS STEEL

Sharon Steel Corp.—A 32-page catalog offers description, chemical composition, strength factors, physical properties and applications for stainless steels, including the 200, 300 and 400 series. Forging ingots and rolled-in surface patterned stainless steels are included.

75 CARBIDE TIPS

Firth Sterling Inc.—New 56-page catalog on carbide tips, tools and inserts. A picture index identifies each product, and the pages have been die cut to expose the beginning of each section. A grade selection chart is included. Authorized distributors are listed.

76 PACKAGE BOILERS

Combustion Engineering, Inc.—Catalog P-139 describes new Type VP package boiler, shop assembled to provide steam capacities from 4000 to 50,000 lb per hour. Space requirements and specifications are in table form.

77 MINIATURE BALL BEARINGS

Miniature Precision Bearing, Inc.—A new 24-page, 3-color catalog, illustrated with comprehensive specifications on more than 500 types and sizes of standard miniature ball bearings from 1/8 mm to 1/8 in. OD, includes material of particular interest to designers of precision mechanisms—applications, lubrication, design variations, special bearings, etc.

78 COMPRESSED AIR UNITS

Hankison Corp.—A 20-page catalog describes construction, operation and performance of compressed air units, combination condenserfilter for instrument air, dehydrofilter for vapor free air lines, condensate discharge trap.

79 HYDRAULIC CYLINDER

Hanna Engrg. Wks.—Four-page folder illustrates and describes a hydraulic cylinder designed specifically for spar mills. Design features are discussed and dimensions given in diagram form.

80 ALCOA HANDBOOK

Aluminum Co. of America—A hard cover book contains data on aluminum alloys and mill products in tabular form. Information is given as reference for those responsible for planning, designing, testing, purchasing and fabricating aluminum successfully. Form 10051.

81 ADJUSTABLE-SPEED DRIVES

Dynamatic Div., Eaton Mfg. Co.—Data Sheets DS 1, 2, 3, 4 and 5 describe a new line of stationary-field, air and liquid-cooled drives that provide infinitely adjustable speeds from an a-c power source. Included are integral motor and coupling combinations from 3 to 75 hp and separately mounted couplings up to 2,000 hp.

82 SHUT-OFF VALVES

Homestead Valve Mfg. Co.—Reference Book 39, Section 8, illustrates and describes No. 202 valves for quick-acting positive shut-off on air lines to power tools, water, gas, oil lines opening to the atmosphere where temperature does not exceed 350 F.

YOUR

New Catalogs GUIDE

83 FORGINGS

Kropp Forge Co.—A 40-page booklet illustrates and describes the firm's facilities and services for producing forgings of steel, titanium and alloys. Data is given on practices and tolerances for impression die forgings, drop forgings, flat die forgings, die sinking and machining.

84 INSTRUMENTATION

Leeds & Northrup Co.—Four page folder and three individual data sheets illustrate and describe features of pressurized, high speed sampling system with new sampling averaging unit, and magnetic O_2 analyzer and electronic recorder. The equipment determines oxygen content in boiler flue gas.

85 PUNCHES AND DIES

T. H. Lewthwaite Machine Co.—Catalog sheets illustrate and describe hand operated punches, cutters, and benders and list large, planned stock of punches and dies to fit most makes of punch presses. New, simplified system of decimal die marking is introduced with charts for determining correct clearance to allow for both type and thickness of metal being punched.

86 GLOBE VALVES

Lunkenheimer Co.—Circular No. 561 describes original clip globe valves for the 125 and 150 lb service applications. Four-page bulletin includes tables of SP and WOG pressure ratings, dimensions, parts identification, and descriptions of the various metals and alloys.

87 VIBRATION TEST EQUIPMENT

MB Mfg. Co.—Eight-page catalog illustrates, describes, and gives specifications of vibration test equipment. Included are specifications for electrodynamic vibration exciters, complex motion testing systems, and electronic power supplies. Other products mentioned are vibration pickups, vibration meters, vibration isolators and absorbers.

88 BOILER SAFETY

McDonnell & Miller, Inc.—A 24-page catalog shows various types of low pressure steam heating boiler installations with safety devices for maintaining a safe minimum level of water. Service recommendations and schematic wiring diagrams are included.

89 CONVEYOR BELTING

Manhattan Rubber Div., Raybestos-Manhattan, Inc.—Catalog 25CB illustrates and describes conveyor and elevation belts. It covers new style designations of general service heavy duty types made with special strength numbers. Tension ratings, minimum pulley diameters and minimum belt widths are given.

90 PRESSURE REGULATORS

Spence Engineering Co.—New four page brochure, No. 1011 covers pressure regulators. Selection data and photos are presented on three principal types of main valves and pilots. Line drawings show three suggested applications of regulators. A steam capacity table for the selection of main valve size is included.

91 PROCESS EQUIPMENT

Pfaudler Co.—Bulletin 936 illustrates and describes glassed steel, alloy reactors, columns, heat exchangers, condensers, evaporation equipment, storage, mixing and trailer tanks.

92 SPECIAL GLASSES

Corning Glass Wks.—Properties of such selected commercial glasses as Pyrex, Corning and Vycor are described in Bulletin B-83. Data and tables on mechanical properties, thermal stresses, heat transmission, electrical properties, corrosion resistance, and viscosity are included.

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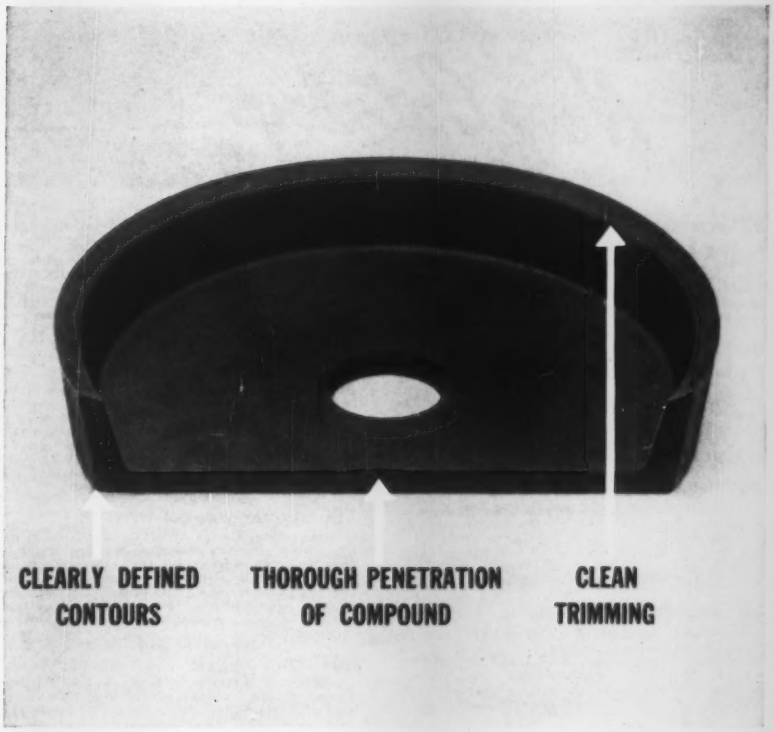

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YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

93 ELECTRIC MOTORS

Sterling Electric Motors, Inc.—A new 20-page catalog lists prices and selection data for the more commonly used electric power drives. The catalog covers normal speed electric motors, geared motors, variable speed transmissions and speed reducers.

94 AUTOMATIC MECHANICAL CLUTCHES

Mercury Clutch Div., Automatic Steel Products, Inc.—An eight-page folder gives specifications, applications and special data on the two general types of clutches for gasoline engines and electric motors. Also listed are representatives who are qualified to assist in the proper selection and application of the firm's clutches.

95 STEAM SURFACE CONDENSERS

Maryland Shipbuilding & Drydock Co., Industrial Products Div.—A brochure describes products and experience of the company in the heat transfer and fabricated machined component parts manufacturing capital equipment industry. Emphasis is on steam surface condensers.

96 MECHANICAL SPRINGS

Associated Spring Corp.—An 84-page manual contains information on spring design, including forms for presenting all details about a particular design needed to prepare the specification. Principles of spring design and fundamental formulas for stress and deflection are included.

97 ALLOY STEELS

Copperweld Steel Co.—A 16-page bulletin covers lead treated steels. Case histories of components made of the material are included, along with data on characteristics and mechanical properties of various leaded alloys.

98 TECHNICAL BOOKS

Reinhold Publishing Corp.—A 68-page annual catalog lists books on materials engineering, metallurgy, automation, physics, plastics, lubrication, paints, fasteners, chemistry, and architecture. Books are classified by subject, and indexed by title, subject, and author. Each listing includes description and complete table of contents.

99 STORAGE WATER HEATERS

Patterson-Kelley Co., Inc.—A 48-page catalog, revised to include the latest provision of the 1952 ASME Code for unfired pressure vessels, features the firm's standard lines of commercial and industrial storage water heaters. Selection tables of capacities and weights, dimensions, hot water fixture capacities, material thicknesses, heating elements, piping diagrams are included.

100 SPECIAL PURPOSE STEEL

Crucible Steel Co. of America—A 232-page catalog describes more than 700 products available from stock at warehouses throughout the country. The book index lists 16 categories, including high speed, tool, stainless, alloy and machinery, available in 16,000 grades and sizes. Estimating, conversions and weight tables are included.

101 STEEL BOILERS

Pacific Steel Boiler Div., National-U.S. Radiator Corp.—A 24-page catalog, AP-364, features the entire line of Pacific Steel Boilers for medium to large size installations as well as SBI table 1 boilers for commerical applications are featured.

102 PRESSURE GAGES

American Chain & Cable Co., Helicoid Gage Div.—The 24-page Helicoid gage catalog describes the Helicoid gage as guaranteed accurate to within 1/2 of 1 per cent of the total dial graduation over the upper 95 per cent of the 270-deg dial arc. Cutaway photographs and line drawings show the complete line of Helicoid gages.

103 FIN RADIATION

Moore Dry Kiln Co.—Bulletin 5308-R illustrates and describes a steel-finned pipe for heating and cooling applications. Surfaces are formed by spirally wound coils of heavy gage steel strip corrugated on inner edge.

104 PROPORTIONING PUMPS

Hills-McCanna Co.—A two-color, eight-page catalog, No. 604, covers details and specifications of the Model U and K mechanical and hydraulic drive metering and proportioning pumps, the Hills-McCannameter for precision pumping as low as 11 cc/min and the new Model 4411 chemical pump for systems requiring limited capacities.

105 O-RINGS

Linear Inc.—Compact 16-page folder contains tables of standard O-ring sizes as well as dimensional data for installation. Notes contain general recommendations on clearances, design material, machining, and finishes for most O-ring applications. A special compound bulletin describing the latest polymers and synthetic rubbers from which O-rings can be molded is also included.

106 ROLLER BEARINGS

Hyatt Bearings Div., General Motors Corp.—Catalog 150 illustrates and describes solid roller bearings, wound roller solid race and split race bearings, industrial inch bearings and solid roller bearings in separable inner race, separable outer race and nonseparable types.

107 FLEXIBLE COUPLINGS

H. S. Watson Co.—Two catalogs illustrate and describe flexible couplings. A four-page catalog presents general information and an eight page catalog gives engineering and selection data for units capable of handling up to 800 hp.

108 ROTARY SLITTING LINES

Yoder Co.—A 75-page handbook provides information on slitters and allied equipment. Basic data on design, selection and operation of slitting lines, and specifications of slitters, uncoilers, recoilers, coil cars, and scrap choppers are included.

109 DIAPHRAGM VALVES

Grinnell Co.—An 8-page catalog describes diaphragm valves offering streamlined fluid passage, flow control, leak-tight closure. Isolation of working parts from fluid stream is said to prevent product contamination and corrosion of operating mechanism. Flexibility of assembly and wide choice of materials for bodies, body linings and diaphragms are described.

110 CENTRIFUGAL PUMP

Corley Co.—Eight-page bulletin illustrates and describes Magnaflow centrifugal pump for open or closed systems, hazardous fluids, contaminables, vacuum pressure and no-loss systems.

111 SPREADER STOKERS

Hoffman Combustion Engineering Co.—Catalog No. 55-CAD describes and illustrates features of moving-grate spreader stokers. Catalog 55-PDG describes, illustrates, and supplies additional information on spreader stokers with dumping grates. Capacities from 20,000 to 500,000 lb of steam per hr.

112 MARKING EQUIPMENT

Jas. H. Matthews & Co., Inc.—Four supplements to catalog 146 include 21 pages describing hand marking stamps and tools; 16 pages describing steel marking dies; 19 pages describing marking machines; 17 pages describing identification checks, badges, tags.

113 ALUMINUM CASTINGS

American Brake Shoe Co.—Brochure shows how to improve design, reduce weight in critical aircraft castings. New high-strength materials, Ductaluminum 356S and Ductaluminum 356T, are described. Improved casting reliability is said to cut shop rejects, reduces machining losses.

careers in peaceful applications of atomic energy

HEAT TRANSFER ANALYSIS

Responsible positions on our Engineering Staff

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Qualifications: BS, MS, or PhD in ME or Chem. E. Prefer 2-5 years' related engineering background. Outstanding opportunities. Perform and direct studies on heat transfer in reactor systems, and on the dynamics and thermodynamics of fluid flow.

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(In the Suburban San Fernando Valley, near Los Angeles)

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

114 CIRCULATING OIL SYSTEMS

Farval Corp.—Bulletin No. 70, an eight page illustrated brochure, provides information on Lubrival, a new type of circulating oil system for presses and other semi-automatic or automatic production equipment. The booklet contains application photos, schematic drawings and description of components.

115 BRONZE, IRON VALVES

Fairbanks Co.—New Catalog 57 provides descriptions and specifications on complete lines of bronze and iron body valves. Bronze valves of all types, including solder and brazed end valves with pressure ratings from 125 to 300 lb steam are covered. Iron body valves of all types, including AWWA and Underwriters Approved, with pressure ratings from 125 to 250 lb steam are listed.

116 SPEED REDUCER

Western Gear Corp.—Catalog 5616 provides engineering information on in-line series of speed reducers identified by the trade name StraitLine, available in double and triple reduction. Double reduction units are offered in 15 standard ratios from 3.39:1 to 57.3:1 with ratings to 100 hp. Triple reduction units are available in 9 ratios from 82.1:1 to 190.7:1 with ratings to 50 hp.

117 BRASS MILL PRODUCTS

Bridgeport Brass Co.—A new 230 page technical handbook on copper-base alloys covers strip, sheet, rod, wire, tube. Details on composition, mechanical and physical properties, suggested applications are included, along with photos, tables, charts.

118 GATE VALVES

Ohio Injector Co.—Bulletin 1007 covers gate line valves in the IBBM series with bronze seat rings and all iron series with nickel plated steel stems and resistant type body bonnet.

119 CUSTOM MOLDING TEFLON

Sparta Mfg. Co.—A four page brochure covers patented process of custom molding parts of Teflon in thin sections and shapes. Properties and characteristics of Teflon, suggested end uses, and illustrations of such parts designed through the process as cup, ball, or shaft seals, washers, gaskets and diaphragms are included.

120 STEEL EXTRUSIONS

Allegheny Ludlum Steel Corp.—Steel extrusions are covered in an 11 page booklet, including use of extrusion in range of steels—carbon, alloy, stainless, tool, and high temperature—and the whole group of special metals that includes titanium, zirconium, and hafnium. In addition to diagraming and explaining the extrusion process, product classification, mechanical properties, design, and tolerances of extrusion are discussed.

121 ROTARY BLOWERS

Roots Connersville Blower Div., Dresser Ind. Bulletin AF-154 describes rotary positive blowers 7-in. gear diameter and smaller. They are rated from 1 to 7 psig and will handle from 10 to 700 cfm of air. Eighteen standard sizes are listed.

122 VIBRATION ISOLATION

Korfund Co.—A four-page bulletin gives information on how to write vibration isolation specifications for air conditioning and related equipment. It contains a definitive treatment of the factors involved in the selection of various isolation media commercially available and has a selector chart designed to simplify writing specifications. Bulletin F2C.

123 HYDRAULIC PRESSES

Lake Erie Machinery Corp.—Bulletin 11 describes hydraulic presses and die casting machines. It incorporates a comprehensive chart relating various types of presses to their production uses. Photos of representative presses and a selection chart are included.

124 ALLOY STEEL PIPE

U. S. Pipe & Fdry. Co., Steel & Tubes Div.—Bulletin illustrates and describes turned and bored, metal mold, centrifugally cast alloy steel pipe. Case histories are given, along with a description of the manufacturing process.

125 ULTRASONIC MACHINING

Sheffield Corp. How to use ultrasonic energy to cut, drill, emboss, engrave, slice, and dice hard and brittle metals and nonmetals is shown in publication No. CAV 7-56. The 16-page illustrated booklet describes the ultrasonic machining process, shows examples of designs and forms machined in carbide, glass, germanium, ferrite and ceramic, and also includes specifications and machining capacities of ultrasonic machine tools.

126 DUPLICATING BALL-POINT PEN

Venus Pen & Pencil Corp. Sample Venus Thermocopy Ball PEN oil is offered free. The pen is designed for use in duplicating processes. Specially formulated super-opaque black ink allows black markings on originals or masters. May be used for Thermofax, Verifax, Diazo, offset, and Chemograph processes.

127 COPPER, COPPER ALLOY

American Brass Co.—A 24 page reference manual contains copper and copper-alloy specifications, including ASTM, ASME, AWS, SAE, AMS, federal, military, Navy, and joint Army-Navy specifications.

128 VERTICAL TURBINE PUMPS

Layne & Bowler, Inc.—A comprehensive book explains vertical turbine pumps. Included in the 72-page hard-bound book are graphic tables, photographs, drawings and charts.

129 SOCKET SCREWS

Allen Mfg. Co.—General catalog, G-57, 40 pages, describes the line of hex socket screws and precision fasteners, including flat and button head cap screws, shoulder screws, pipe plugs, dowel pins, Allenuts, and hex keys. Included are engineering data and standards pertaining to socket screws.

130 ALCOA PIPE AND FITTINGS

Aluminum Co. of America. A 20 page booklet covers process piping, pipelines, portable piping, structural piping applications, fittings and flanges, installation, dimensions and weights of aluminum pipe and fittings. Form 10197.

131 ROLLER CHAIN

Acme Chain Corp.—A new illustrated 100 page catalog covers precision roller chain and sprockets, flexible couplings, special conveyor attachments. Horsepower charts and standards, plus new engineering section showing diagrams of 36 methods of chain adjustments to assist in design and application problems are presented.

132 HEAT EXCHANGERS

Niagara Blower Co. Bulletin 130 describes Aeroheat exchanger with installation photographs and diagram explaining functions. New design equipment simplifies maintenance with complete access to all parts. Panel casing construction reduces first cost and upkeep, the bulletin says.

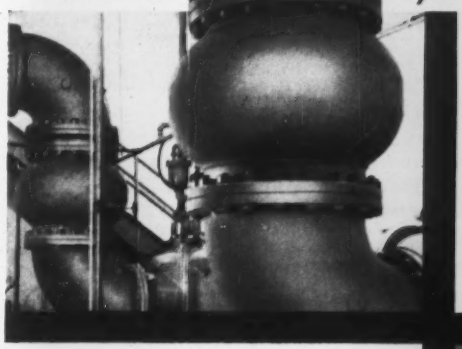
133 PACKINGS, GASKETS

Crane Packing Co.—A 12 page booklet illustrates and describes the firm's Teflon mechanical and hydraulic packings, sheets, rods, tubing, tape, flexible bellows, gaskets, custom molded and machine parts, electrical and electronic parts.

134 SCREW THREAD STANDARD

O-Vee Gauge Co.—"Screw Thread Standard H 28" has been revised and reprinted and issued Sept. 1957. New gaging requirements are discussed and described in a brochure, illustrated by diagrams.

Another System Made



SAFE FROM WATER HAMMER

Here is protection against damage from surge pressures . . . the means to eliminate resulting water hammer. They operate instantly when flow reversal starts or when flow is zero. Write for descriptive Bulletins.

WILLIAMS-HAGER Silent CHECK VALVES

Write for Bulletins No. 654 on the Valves; No. 851 on Cause, Effect and Control of Water Hammer.

THE WILLIAMS GAUGE CO., INC.

149 STANWIX STREET

2 GATEWAY CENTER PITTSBURGH 22, PA.

Our 71st Year • 1886-1957

Norblo gives you continuous peak-load Dust Collection through automatic bag cleaning

Plants running full blast can ill-afford down time for equipment repairs and maintenance. Dust collection around the clock without interruption is commonplace with Norblo Automatic Bag Type Arresters.

Complete time-cycles for progressive automatic bag shaking are controlled by highly efficient electric timers. Only one compartment is cut out at a time, and that for just a few seconds, with *no* drop in efficiency for the installation as a whole. Norblo's compartment construction is the time-saving solution to inspection, maintenance and repair in busy plants . . . For "good housekeeping" or for salvage, Norblo Automatic installations have many design advantages wherever continuous high recovery of industrial dusts and fumes is important.

It pays you to write at once for latest information on Norblo Automatic Bag Type Dust Arrester that assures constant high efficiency dust handling.

THE NORTHERN BLOWER COMPANY

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Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

YOUR New Catalogs GUIDE

135 STRUCTURAL PANEL

Philip Carey Mfg. Co.—A folder, Form No. 6293 describes a 2-in-1 insulated structural panel for interior use in duct construction, industrial ovens, coil housings, plenum chambers. It is formed of laminated plies of corrugated and flat asbestos paper sheets, bonded with a fire-resistant adhesive.

136 METERED LUBRICATION

Bijur Lubricating Corp.—A four-page bulletin "The ABC of Modern Lubrication" describes automatic lubricating system components. All systems consist of a lubricator, distribution system and a Meter-Unit for each bearing served. The bulletin describes lubricators for rotary, oscillating, hydraulic, solenoid, or hand operation.

137 POWER PLANT EQUIPMENT

Copes-Vulcan Div., Blaw-Knox Co.—Bulletin No. 1022A describes a line of power plant equipment which includes automatic combustion control, boiler feedwater control and soot blowing systems, desuperheating and pressure reducing stations, and rotary and retractable soot blowers. According to the bulletin, the firm offers a completely integrated system for the control of combustion, feedwater, steam temperature and boiler cleaning. It is available in a single package or as individual systems to meet specifications.

138 OIL AND GAS BURNERS

Engineer Co.—Bulletin OB-53 illustrates different types and sizes of gas and oil burners and includes engineering data and specifications for pumping and heating sets for all types of liquid fuels.

139 BOILER SAFETY DEVICES

Reliance Gauge Column Co.—Bulletin 516 is a condensed catalog of water columns, water-level gages and accessories, and liquid-level alarms. It is a key to more complete catalog sections describing this class of equipment as made by Reliance.

140 BALL BEARINGS

Federal Ball Bearings Co.—Catalog D-1 contains 24 pages of dimensional tables for selection of ball bearings according to size, and assists in the identification of ball bearings for which a repalcement is required. Both metric and inch measurements are shown. Catalog also includes interchange and conversion tables.

141 HOISTS, CRANES

Detroit Hoist & Machine Co.—Bulletin 850 describes the Detroiter, a hoist that can be equipped with either electric or air motor. The firm specializes in equipment for use in explosive atmospheric conditions.

142 GENERAL SERVICE PUMPS

C. H. Wheeler Mfg. Co.—Five bulletins are offered. D-100 and E-100 cover general service pumps; E-101 covers nonclog sump pumps; F-100 covers vertical nonclog pumps; F-101 covers horizontal nonclog pumps.

143 SUPER REFRACTORIES

Carborundum Co., Refractories Div.—"Properties of Super Refractories," twenty-four pages, covers latest data on super refractories including newly developed compositions for specialized applications. Re-frax silicon-nitride bonded silicon carbide refractories which can be produced in intricately designed shapes to close dimensional tolerances is described. Chemical analysis and physical property charts are provided on all materials.

144 BALL BEARING SWIVEL JOINTS

Chiksan Co.—A revised 32-page catalog, G-4R covers the company's line of ball-bearing swivel joints, loading racks, manifolding lines, all-metal marine and barge hose, and flexible aircraft assemblies. Typical industrial applications are illustrated and dimensional and operating data is provided.

145 CLEANABLE FILTERS

Cuno Engineering Corp.—Literature covers Auto-Klean and Super Auto-Klean edge-type cleanable filters, and filters for built-in installations, and Micro-Screen filter elements of reinforced screen mesh.

YOUR

New Catalogs GUIDE

146 SILICONE PRODUCTS

Garlock Packing Co.—An eight-page bulletin No. AD-147 covers silicone products for use in diaphragms, gasketing, sheet packing, oil seals, rings, insulation, tape, rod and valve stem packings, and for molded, extruded, die-cut and metal-bonded shapes for various uses. Silicone sponge applications are included.

147 OPTICAL INSTRUMENTS

Bausch & Lomb Optical Co.—A booklet, "Industrial Optical Aids," contains information on an assortment of inexpensive precision optical instruments and suggests ways to use them to gain faster, easier, lower-cost production. Items discussed include magnifiers, microscopes, wide field tubes, macroscopes and comparators. Catalog D-1059.

148 SILICONE RUBBER COMPOUNDS

Acushnet Process Co.—Literature describes silicone rubber compounds and expanded services for the molding of precision parts now available from the company. Increased service temperatures to 500 F and for limited periods to 600 F are offered by five new compounds. Three compounds with low shrinkage characteristics in the 50 to 70 durometer range permit molding of parts and holding of close tolerance in existing tools.

149 BALL BEARINGS

New Departure Div., General Motors Corp.—A 36-page booklet illustrates and describes miniature precision instrument ball bearings. Data is given on each series, along with engineering and performance information.

150 RESERVOIRS, STANDPIPES

Koven Fabricators, Inc.—Bulletin 555 describes and illustrates steel reservoirs and standpipes designed to provide water storage from 50,000 to 2,500,000 gal. Bulletin 501 covers stress relieving, X-ray inspection, hot dip galvanizing and finishing done by the company.

151 STEREOMICROSCOPES

Bausch & Lomb—A catalog discusses principles and equipment used in connection with stereomicroscopy. A guide to the selection of stereomicroscopes and accessories is included, along with reproductions of specimens seen through this medium. Catalog D-15.

152 PH STAINLESS STEELS

Armco Steel Corp.—20-page booklet of case histories with illustrations tells how Armco 17-7 PH and 17-4 PH (precipitation hardening) stainless steel bar and wire improve product design and performance at low cost. Typical mechanical properties of both grades of bar and wire are also given.

153 POWER TRANSMISSION PRODUCTS

Boston Gear Works.—A 576-page, pocket-sized catalog contains information on 7,124 standardized power transmission products. More than 50 pages of engineering data are included.

154 PIPE HANGER

National Valve & Mfg. Co.—Bulletin No. 157 gives specifications for pipe hangers, engineering drawings of all models, weight-load selection tables and erection and adjustment information. Levelglide hangers, which permit horizontal movement of piping systems, also are described.

155 SAFETY CONTROLS

McDonnell & Miller, Inc.—Eight-page catalog covers typical hot water space heating boiler systems, showing proper positioning of safety devices to guard against over pressure and low water. Service recommendations are included.

156 VALVES

Republic Mfg. Co.—Catalog No. 654A, 72 pages, illustrates and gives specifications on needle, globe, plug, check, relief, selector valves for industrial, chemical and aviation uses.

157 AUTOMATION EQUIPMENT

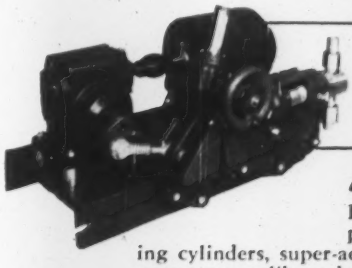
Patterson-Emerson-Comstock, Inc. Automation Div.—A 16-page, illustrated brochure on automation, written in nontechnical language, covers the broader aspects of automation and indicates some procedures that have been found useful within the process industries.

Scale deposits on steam turbine blading. Photo courtesy of Hartford Steam Boiler Inspection & Insurance Co.

No Build-Up! No Blow-Up!

. . WHEN MODEL 1106 PROPORTIONEER FEEDS BOILER WATER CHEMICALS

Prevent scale build-up (caused by boiler carry-over) on turbine blades with proper raw water or internal steam boiler treatment. Model 1106 Proportioneer feeds all chemicals (alkaline, neutral, or acid) accurately (guaranteed within ±1%) over 15 to 1 range. Capacities range from 0.11 to 35.6 GPH . . . for discharge pressures up to 1100 psig.



In-Motion Stroke Adjustment offers the ultimate in convenience for controlled chemical feeding. Stroke length adjustable (no tools required) in stepless increments over entire range of pump while pump is in operation!

PAY LESS, GET MORE!

Design features of this proportioning pump include interchangeable measuring cylinders, super-accurate Vane-Guide check valves, and percentage calibrated stroke-length scale.

Request Bulletin 1106-2 for complete data. Write to **PROPORTIONEERS, INC., 382 Harris Avenue, Providence 1, Rhode Island.**

PROPORTIONEERS
DIVISION OF
B-I-F INDUSTRIES
BIF METERS FEEDERS CONTROLS

Bubbles in boiling liquid were "frozen" with stop motion by photographer Bernard Hoffman.

Controlling Temperature in Fluid Engineering

Heat is generally only one part of your problem. Pressure, abrasion or corrosion factors usually must be taken into account, too. So if your past experience offers no precedent, you can look to S. Morgan Smith's specialized engineering leadership for assistance.

A number of materials are available to meet extreme working conditions. Here the broad SMS background combines with specialized valve engineering to help you. Perhaps R-S Butterfly Valves can be applied to control volume and flow at high temperatures. Or, if heat and corrosion make extremely accurate timing and fast, drop-tight closure a tough problem, an SMS Rotovalve could be the answer. Whatever your special processing needs, you can get help in protecting your equipment investment.

There is a full SMS line – standard R-S Butterfly Valves ready for fast assembly and shipment from stock, Rotovalves and Ball Valves. A call to our nearest representative will bring information. Or, write S. Morgan Smith, York, Pa., for data on standard valves or special applications.

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Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

YOUR *New Catalogs* GUIDE

158 ALUMINUM

Revere Copper & Brass, Inc.—"Revere Aluminum Products" 36 pages, discusses the advantages of aluminum alloys, the variety of extruded products available, the uses to which seamless drawn tube and pipe can be put, and the uses of sheet, bus bar, and die pressed forgings. It contains many tables giving both mechanical and physical properties.

159 OIL-RETAINING BEARINGS

Bound Brook Oil-Less Bearing Co.—More than 600 of the most widely used sizes of oil-retaining porous bronze bearings are listed in the firm's Stock List No. 4. Also provided is condensed information on application, installation, lubrication and machining.

160 FRACTIONAL HP MOTORS

Robbins & Myers, Inc.—A ten-page booklet describes its new line of Model R re-rated fractional horsepower motors available in ratings from 1/8 to 1 hp in polyphase, capacitor single phase, permanent split capacitor and (in the smaller ranges) split phase types. Totally enclosed designs are included.

161 FLOAT, THERMOSTATIC TRAP

Warren Webster & Co.—Bulletin B-1205 describes a new series of float and thermostatic traps for steam pressures to 150 lb per sq in. Traps are now made with 3/4, 1 and 1 1/4 in connections. Bulletin gives construction details, ratings and suggested specifications.

162 BIN LEVEL CONTROLS

Bin-Dicator Co.—Catalog describes and illustrates bin level indicators including new Roto-Bin-Dicator and Bin-Flo aerator units. Dimensional drawings, mounting details, typical applications, wiring diagrams, and list of present users.

163 INDUSTRIAL COOLING FANS

Koppers Company, Inc., Metal Products Div.—A 4-page folder illustrates and describes new, all-metal, "Precision Engineered" Aeromaster fans for cooling towers and radiator type coolers. Design features are discussed.

164 BOILERS

Brown Fintube Co.—Bulletin No. 554 illustrates and describes the construction, operation, controls of boilers in capacities of from 30 to 350 hp. Dimensions and specifications are tabled.

165 TESTING DEVICES

Baldwin-Lima-Hamilton Corp., Electronics & Instrumentation Div.—Bulletin 4300 lists SR-4 devices and equipment for load, torque and fluid pressure measurement and control. Numerous application photos in all fields are included in this 20-page bulletin.

166 CENTRIFUGAL PUMPS

Dean Bros. Pumps Inc.—Circular No. 190 illustrates Type GS standard centrifugal pumps for general and chemical service. Design and construction data is given, along with a sectional view and parts list and dimension prints of the various units in the series.

167 TECHNICAL BOOKS FOR ENGINEERS

Ronald Press—Brochures containing detailed descriptions of current technical books on mechanics, engineering, aeronautics, industrial management, metallurgy, applied and physical sciences, etc. Practical reference works like the Ronald Handbooks, basic studies, and pioneering works on the latest engineering and scientific developments are included.

168 MATERIALS HANDLING

Syntron Co.—A condensed catalog, No. 577, contains 50 pages of technical data, brief description and photographs of bin vibrators, vibratory feeders, vibratory conveyors, power tools, shaft seals, selenium rectifiers, vibrating parts feeders, heating elements and other equipment.

169 FLEXIBLE METAL HOSE

Flexonics Corp.—A 12-page catalog covers line of Flexon flexible metal hose. The three main types of flexible metal hose and their specifications are given, typical applications are told, couplings available described, and a chart on how to select metal hose is included.

YOUR

New Catalogs GUIDE

170 GAS-FIRED HEATERS

Reznor Mfg. Co.—Bulletin GN-57 gives specifications, dimensions and application and installation information on gas-fired unit heaters and duct furnaces. Capacities on unit heaters range from 25,000 to 300,000 Btu. Individual unit capacities for duct furnaces range from 50,000 to 300,000 Btu; system capacities in excess of 2,000,000 Btu are obtainable through sectional assembly.

171 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Catalog F-400 contains illustrations, descriptions and engineering data on grating-flooring, treads, and floor armoring (riveted, press-locked, welded types) for industrial and power plants and refinery walkways, stairways, driveways, trucking aisles; ship cat-walks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring expansion joints catch basin covers; bridge decking.

172 COOLING TOWER FANS

Marley Co.—New 12-page bulletin describes development of the company's multi blade fans made in sizes from 4 to 22 ft in diameter. Performance and service advantages attributed to this type of equipment are outlined.

173 HARD CARBIDES

Kennametal, Inc.—A 44-page booklet describes basic design principles for use of hard carbides; methods of forming; methods of fastening carbides mechanically; and a general treatise of Kennametal and suggested fields of application.

174 VACUUM PUMPS

Leiman Bros., Inc.—A 416-page catalog, No. 1957, describes rotary positive air and vacuum pumps, gas boosters and air motors. Included are 2 and 4 wing types; fan-cooled, water-cooled and new radiator air-cooled models; motor driven units; direct-coupled and belt-driven models; integral pump and motor; automatically controlled tank units; accessories.

175 CIRCULAR FORGINGS

Alco Products, Inc.—A 16-page bulletin describes production of ring forgings using company's quality-controlled steel. Bulletin documents company's technical experience; contains four-page table for use in calculating weights of rings from 1 to 146 in. in diameter.

176 ABSORPTION REFRIGERATION SYSTEMS

Black, Sivalls & Bryson, Inc.—Catalog 33-10 describes new ammonia absorption refrigeration unit for gas processing that requires temperatures below ordinary atmospheric level. The unit can be used for hydrocarbon dewpoint control in pipelines, to increase hydrocarbon recovery with low temperature separation units where there is no available pressure expansion, and to increase gasoline plant hydrocarbon recovery up to 100 per cent by chilling the absorption oil.

177 PACKAGED STEAM GENERATORS

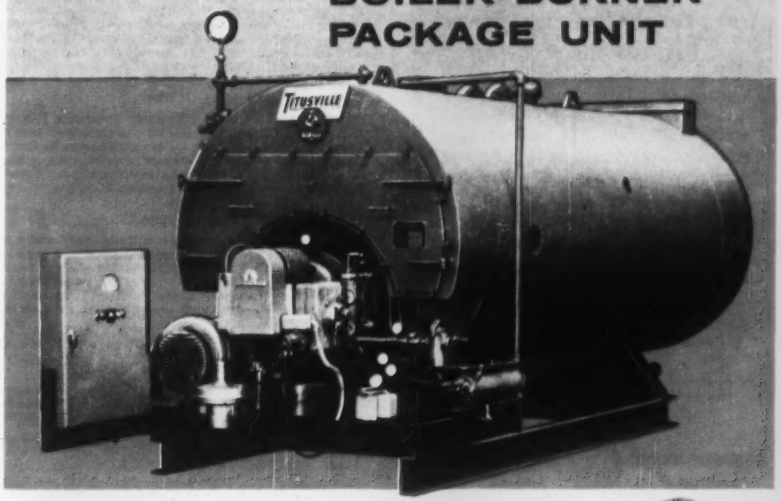
Union Iron Works—A 16-page bulletin, MH 3-54, describes Union Type MH packaged water tube steam generators equipped for oil or gas firing or both, with automatic, semi-automatic or manual combustion controls. Included are cutaway illustrations, tube arrangement layouts, photo-sequence story of actual shop assembly and dimension tables for 13 standard sizes from 10,000 to 60,000 lb of steam per hour.

PAST EXAMINATIONS
for Professional Engineers given by New York State

This pamphlet contains the questions given in 1952–1956 examinations. They cover problems in structural planning and design, in practical applications of basic engineering sciences, and the more advanced and specialized problems in practical applications of engineering principles and methods.

$2.00 (20% Discount to ASME members)
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 W. 39th St., New York 18, N. Y.

NOW...THE TITUSVILLE 3pass BOILER-BURNER PACKAGE UNIT



WITH 80% PLUS CERTIFIED EFFICIENCY!

As pioneer and master-builder of Scotch Marine type boilers, TITUSVILLE is proud to present the 3-PASS boiler-burner package unit for high and low pressure and hot water. Offering the highest efficiency obtainable, these new 3-Pass boilers provide economy in service so great as to return the entire investment cost over a few years of operation. Designed for use with any of the leading makes of burners, and for gas, oil, or gas-oil combinations, Titusville 3-Pass boiler-burner units are available in ten sizes, with heating surfaces from 358 to 3571 sq ft. Write for the facts, and a quotation on your requirements.

THE TITUSVILLE IRON WORKS CO.

BOILER DIVISION
BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

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Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

FORGE DIVISION
Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

A Division of
Struthers Wells

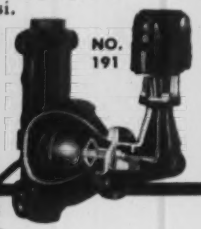
TITUSVILLE, PENNSYLVANIA
Manufacturers of A Complete Line of Boilers for Every Heating and Power Requirement
Plants at Titusville, Pa. and Warren, Pa.
Offices in Principal Cities

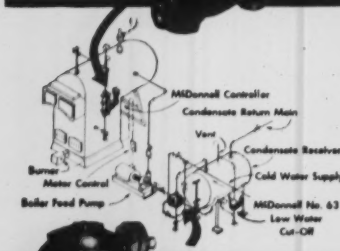
McDonnell Answer

... for boilers up to 150 psi

McDONNELL No. 191
Water Column Type Pump Control Cut-off and Alarm Switch

Controls the boiler feed pump the one right way—from the boiler water level itself. Introduces new repulsion magnetic switching for positive opening *and* closing. Quality is attested by its use as standard equipment on many fine "package" boilers. Other repulsion switching types for boilers up to 250 psi.





McDONNELL No. 27T MAKE-UP WATER FEEDER

Automatically adds water to condensate receiver to make-up for any defficiency in returns. Has large feeding capacity to meet any sudden boiler demand. Stainless steel needle and seat assure drip-tight closing. For tank pressures to 35 psi., supply pressures to 100 psi.

Write for Bulletin L-123

McDONNELL & MILLER, Inc.
3510 Spaulding Ave., Chicago 18, Illinois

Doing One Thing Well

McDONNELL
Boiler Water Level Controls and Safety Devices

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

178 TOOL BITS

Firth Sterling Inc.—A catalog covers high speed steel tool bits. Typical analyses of five grades of high speed steel are included, with sizes, standard package quantities, weights per package, and prices. Authorized distributors are listed.

179 AIR CONTROL VALVE

Hanna Engrg. Wks.—Catalog 262 gives data and dimensions on Flo-Pilot air control valves which have a small synthetic rubber boot that snaps into place around the valve stem to seal out dirt and abrasives. The same valve can be used either as two- or three-way.

180 MECHANICAL TUBING

Babcock & Wilcox Co., Tubular Products Div.—Bulletin TB-340 is a guide to the choice of seamless mechanical tubing. This eight-page bulletin describes the various methods of producing seamless mechanical tubing, the several types of surface finishes and machining qualities.

181 LIQUID LEVEL GAGES

Jerguson Gage & Valve Co.—Condensed catalog No. 305 illustrates standard and special function gages and valves, giving dimensional drawings, construction features, pressure-temperature graphs and ratings, materials, and tables of sizes, specifications and standard and optional features. Illustrated with photographs and drawings.

182 PACKAGED STEAM GENERATORS

Superior Combustion Industries, Inc.—Packaged water tube type D Superior steam generators with capacities to 50,000 lb of steam per hour are described in a 12-page bulletin.

183 ELECTRONIC CONTROLS

Dynamatic Div., Eaton Mfg. Co.—Bulletin EC2 covers the construction, performance and maintenance of electronic controls used on the firm's eddy-current adjustable speed drives and other equipment.

184 ELECTRICAL HEATING UNITS

Edwin L. Wiegand Co.—Booklet illustrating and describing 101 ways to apply electric heat and showing approved methods of electrically heating liquids, air, gases, machine parts and process equipment. All items are illustrated and described in detail and varied applications are shown. The heating units go under the trade name of Chromlox.

185 OIL FILTERS, STRAINERS, OILING DEVICES

Wm. W. Nugent & Co., Inc.—Seven bulletins: No. 6 illustrates and describes Nugent pressure strainers; No. 7 gravity filters; No. 7A pressure filters; No. 8 tanks, pumps, shaft oilers; No. 14 oiling and filtering systems for turbines, paper mills, steel mills, pumps, compressors; No. 15 oiling devices; No. 16 sight feed valves, multiple oilers, flow indicators, sight overflows, and compression union fittings.

186 GATE, GLOBE VALVES

Wm. Powell Co.—A 24-page condensed catalog (revised edition) illustrates and describes gate, globe, angle, check, Y, flush bottom tank, lubricated plug, valves in bronze, iron, steel and corrosion-resistant metals and alloys. It lists available sizes and pressure-temperature ratings.

187 OPTICAL TOOLING

Charles Bruning Co.—A 20-page illustrated booklet, explaining the theory, principles, and practice of the new technique of optical tooling. The booklet shows how optical tooling provides tolerances of .003 in. in 100 ft. It is claimed to offer easier construction, assembly, inspection, and insurpassed dimensional control in erecting jigs, fixtures, and assembly structures.

188 VIBRATING FEEDERS

Carrier Conveyor Corp.—Natural frequency mechanical vibrating feeders are illustrated and described in Bulletin No. 1001. No complicated electrical equipment is used in these feeders which come in standard widths to 72 in. and lengths to 12 ft. Special high temperature models for 1800 F material are available. All models are available with fixed or variable feed rate drives.

189 PLANT CLEANING GUIDE

Oakite Products, Inc.—Booklet F 9394R3 incorporates charts of equipment, cleaning methods, solutions, concentrations, temperatures, cleaning equipment. It covers cleaning, descaling, derusting, paint stripping, rust prevention, sanitizing, treatment of water in humidifying, air conditioning, refrigerating units. Steam and hot spray cleaning devices are described.

190 BOILER FEED PUMPS

Pacific Pumps Inc.—Bulletin 122 illustrates and describes boiler feed pumps for high-pressure service. Included are 4-color cutaway photos showing features of the pumps, a performance chart and a discussion of pump design and manufacturing.

191 FILTERS

Air-Maze Corp.—General catalog describes entire line of air filters and liquid filters, including oil bath air filters for engines, compressors, blowers, heating and ventilating filters and electrostatic precipitators, all metal, cleanable liquid strainers offering down to 10 micron filtration, odor eliminator panels, intake silencers, exhaust spark arresters.

192 STOOLS, CHAIRS

Cramer Posture Chair Co.—A brochure illustrates different models of stools and posture chairs. Engineering drawings and photographs show exclusive forward tilt, adjustable footring, finger-tip adjustments and foldaway back.

193 MULTI-V DRIVES

Worthington Corp.—A 100-page master engineering manual presents a scientific and simplified method for rating V-belts. Tables on drive selection contain nearly every possible stock sheave combination. Information on products and range of stock size sheaves with bore limitations is included.

194 ELECTRONIC TEST EQUIPMENT

Panoramic Radio Products Inc.—A catalog digest contains condensed information on standard instruments for applications requiring high speed spectrum or waveform analysis. Included are sonic analyzers, sonic response indicator, signal alternator, triangular wave generator, ultrasonic analyzer, response indicator, sweep generator, spectrum analyzers, band-pass amplifier, oscilloscope cameras.

195 STATIC PRESSURE SEAL

Precision Rubber Products Corp.—An 8-page bulletin gives engineering data on Dyna-Seal, a one-piece seal with an inner sealing ring of resilient deformable synthetic rubber bonded to an outer confining steel ring. It is designed for sealing under bolt heads and such abutment flanges as the pipe union.

196 MOTOR SELECTION

General Electric Co., Motor Dept.—Bulletin GEA-6200, covering a-c motors of 1 to 30 hp, is designed to answer questions concerning the purchase of motors for machines. Service, stocking, motor enclosures, drive requirements, mounting requirements, application information are illustrated and described.

197 AUTOMATIC BOILERS

Orr & Sembower, Inc.—Bulletin 1241 covers Powermaster packaged automatic boilers for light oil, heavy oil, gas or combination gas-oil firing in sizes to 500 hp. pressures to 250 psi. The units are completely factory assembled and have fully automatic operating and safety controls.

198 INSULATED PIPING

Ric-Wil, Inc.—A 20-page catalog, No. 57-1, describes prefabricated insulated piping for underground or overhead distribution of steam, oil, hot or chilled water, process liquids, large-diameter prefabricated conduits for housing all utility services; and various related equipment including conduit and pipe testing caps, insulation fittings for 90-deg elbows and unloading slings.

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LATEST INDUSTRIAL LITERATURE

199 ALLOY STEELS

Bethlehem Steel Co.—A 36-page booklet contains 20 brief articles on elements, grain size, heat-treatment, quenching media, depth-hardness, and other pertinent topics; also several pages of tables on standard alloy steels, tentative standard steels, boron steels, H-steels.

200 METERS, CONTROLS

Bailey Meter Co.—More than 100 measuring, transmitting, receiving, recording, and indicating instruments and control components for power and process applications are described in an 8-page bulletin G15-1. Included are references for each product and 24 instrument and control applications. Addresses and phone numbers of all district offices also listed.

201 HIGH TEMPERATURE WATER GENERATORS

International Boiler Wks. Co.—High temperature water generators are described in a 10-page bulletin, No. 700. Covered are specific features of forced recirculation generators; reasons are given on why high temperature water sytems are being selected in preference to high pressure steam systems.

202 WHITEPRINT MATERIALS

Ozalid Div., General Aniline & Film Corp.—A bulletin describing the advantages of using sensitized whiteprint materials. Literature suggests how intermediate materials will enable design engineers, draftsmen, and technicians to cut drafting time, speed design changes, safeguard valuable originals and make complete prints.

203 BOILER-FEED PUMPS

Worthington Corp.—Bulletin W-318-B23 illustrates and describes types UNB and-UB-12 two-stage centrifugal boiler-feed pumps in capacities to 2500 gpm, heads to 900 ft. Cross sections of each type are shown, along with dimension diagrams.

204 TORQUE CONVERTERS

National Supply Co.—Bulletin No. 468 describes single-stage torque converters for heavy industrial service, discussing background, design, types, sizes, circuits and applications. It also contains a capacity chart of the six sizes and 17 input ratings. Data sheets give application and dimension data of each of the six sizes, with performance curves, capacity chart, important features and typical torque converter arrangements.

205 SPHERICAL ROLLER BEARINGS

SKF Industries—Bulletin No. 443 discusses the company's improved (Type C) spherical roller bearing which is said to increase capacity 25 to 50 per cent and service life 2 to 3½ times. All bearings having a 140 mm or larger outside diameter also have a new lubricating feature in which the lubricant is channeled directly to the center of the bearing, completely covering all working surfaces. The booklet also lists several series of pillow blocks which are furnished with "C" type bearings, and a new line of "Take-Up" units.

206 COMPRESSOR VALVES

J.H.H. Voss Co.—Bulletin 53-G covers valves for air, gas or ammonia compressors. The valves are machined from solid stock; plates are machined and ground; valves and plates are of heat treated alloy or stainless steel and are specially designed to fit the individual characteristics of the compressor for which they are manufactured.

207 COUPLINGS

Snap-Tite, Inc.—Four bulletins and various data sheets cover couplings for high pressure systems, gravity flow systems, vacuum systems and hydraulic systems. Cutaway photos, diagrams and flow charts are included in the literature.

208 SELF-LOCKING SCREWS

Standard Pressed Steel Co.—A 16-page booklet on self-locking socket head cap and set screws describes self-locking insert, gives specifications and performance data on material. Sizes, dimensions and packaging information is included.

209 DROP FORGED VALVES

Henry Vogt Machine Co.—New 32-page Supplement No. 1 to Catalog F-9 covers GP gate, globe, and angle valves, in sizes ½ through 2 in. for 150-800 lb service. They feature 13 per cent chrome stainless trim with hard facings. All stainless valves and many trims are also covered.

210 LUBRICATION EQUIPMENT

Universal Lubricating Systems, Inc.—A catalog covers air couplers, ball swivels, buttonhead couplers and fittings, drain plugs, flush type fittings, grease fittings, hose and guns, hose adapters, needle type adapters, swivel couplers.

211 VALVES, CONTROLS

Hays Mfg. Co.—A packet of data sheets covers the firm's lines of solenoid valves, controls, strainers and automatic interlocks. Specifications, dimensions and flow charts are given.

212 TIMING BELT

United States Rubber Co., Mechanical Goods Div.—A set of manuals illustrate and describe, with drive tables, the PowerGrip timing belt. This drive is said to assure tooth grip precision, and for power transmission its steel cable tension member provides horsepower that ranges from 1/100 to 600 and up, without stretch.

213 AIR DIRECTIONAL VALVES

Westinghouse Air Brake Co.—An eight-page catalog describes two-, three-, and four-way spool type directional valves with solenoid, lever, push button, pilot cylinder, cam, treadle and pedal operators. Valves have tapped exhaust or open exhaust. In neutral, spools close all passages, connect delivery passages to exhaust or connect delivery passages to supply.

214 DRAFTING ROOM EQUIPMENT

Hamilton Mfg. Co.—Catalog No. 14 lists steel and wood drawing tables and files for every drafting room need. It includes comprehensive data on the Auto-Shift drafting table, and information about the shallow-drawer unit with tracing lifter.

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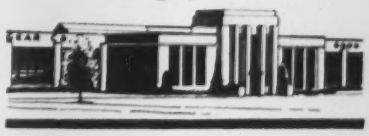

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215 COAGULATOR

Hungerford & Terry, Inc.—A 16-page bulletin illustrates and describes a new coagulator which is a high speed upflow solids contact type coagulation and settling unit for use in water clarification, water softening and waste water treatment.

216 STEAM TURBINES

Terry Steam Turbine Co.—Bulletins in looseleaf form which cover a complete description of Terry solid wheel turbines with cross section drawings of typical units for both moderate and high steam pressure conditions: a description of the Terry axial flow impulse, both single stage and multistage; Terry gears which are used for speed increasing and speed reducing.

217 FORGINGS

United States Steel Corp.—A booklet illustrates and describes the manufacture and application of generator, turbine and waterwheel forgings, anvil bases and columns, forged shafts, forged steel rolls and sleeves, forged blooms, billets and rounds, and miscellaneous forgings. A history of forging is included in the booklet.

218 MECHANICAL-OPTICAL FACILITIES

Kollmorgen Optical Corp.—Bulletin 500 describes facilities for precision mechanical and optical manufacturing. It includes engineering and inspection equipment, plus narrative outlining company's activities in the fields of atomic energy, nuclear research and remote observation, with emphasis on industrial periscopes of which it is a prime supplier for government and commercial use.

219 CLAD STEEL EQUIPMENT

Lukens Steel Co.—A 28-page booklet covers the development, manufacture and properties of clad steels, the types of cladding materials available, design considerations, fabrication techniques and clad steel equipment applications.

220 TORQUE CONVERTERS

Twin Disc Clutch Co.—Bulletin 508 describes a new line of single-stage torque converters. Illustrations and diagrams to permit tentative selection of a torque converter for industrial engines ranging from 30 to 205 hp.

221 GLASS-BONDED MICA

Mycalex Corp. of America—A revised engineering data file, contain technical information, design considerations and suggested applications of the company's Supramica ceramoplastic and Mycalex glass-bonded mica products. Charts of electrical and thermal characteristics and tabular data on the physical properties of the materials are included.

222 CENTER GUIDED CHECK VALVE

Miller Valve Co. Inc.—An eight-page bulletin illustrates and describes the Streamflow center guided check valve, said to be silent and shock-proof, and which can be installed vertically or horizontally. Specifications and dimensions are tabled.

223 THERMOCOUPLE SYSTEM CALIBRATOR

Pace Engineering Co.—A manual gives the theory and operation of equipment for calibrating multichannel thermocouple recording systems. The Calibrator is one in which the reference temperature and scale are established by injection of monitored voltages supplied by two mercury cells.

224 ELECTRIC HEATING UNITS

Edwin L. Wiegand Co.—Catalog 50 covers specifications, construction details, application data, and prices of their complete line of electric heating units. Models are available with strip, ring, tubular, and cartridge heating elements. Also described are immersion, circulation, radiant, and forced-air duct heaters. Charts and tables are provided.

225 LIQUID METERING EQUIPMENT

Black, Sivalls & Bryson, Inc.—The firm's line of fully automatic liquid metering equipment for handling lease produced liquids is outlined in a 24-page catalog. The line includes metering separators, chambers, tanks and test treaters. Any of the items may be used independently or as an integral part of the firm's lease system.

226 HEAVY DUTY COMPRESSORS

Pennsylvania Pump & Compressor Co.—Single stage, horizontal, water cooled, heavy duty air compressors in sizes from 10 to 125 hp and for pressures to 150 psig covered in Bulletin 201-E.

227 LIMIT SWITCHES

National Acme Co.—Bulletin EM-51 covers the firm's line of heavy duty limit switches designed to meet severe mechanical and electrical conditions imposed by heavy duty machine tools. EM-5512 illustrates a new single pole, double make, double break snap-action series of switches and EM-5524 illustrates a double pole, double throw, quick make-quick break series.

228 STANDARD MOTORS

Sterling Electric Motors, Inc.—A 12-page colored brochure describes the firm's line of standard electric motors. The bulletin illustrates applications and contains selection information. Exclusive design advantages are described.

229 MARINE BOILERS

Lookout Boiler & Mfg. Co.—Bulletin 109 illustrates and describes marine boilers with gas burners and automatic controls in nine sizes from 10 to 80 hp, 100 or 125 lb working pressure.

230 VINYL VALVES

Lunkenheimer Co.—Circular 601 describes new all-molded polyvinyl chloride valves, which are light-weight and corrosion resistant. Molded in rigid form, the valve is said to be suitable for pressures up to 125 psi and temperatures to 150 F. Large, cutaway illustration shows design detail. The circular lists industrial fluids these valves handle, features of valves, and dimensions.

231 STEAM, HOT WATER GENERATORS

Cyclotherm Div., National-U.S. Radiator Corp.—Cyclonic combustion is described and illustrated in this new bulletin, which details package-boiler process for transferring 65 to 70 per cent of fuel heat energy in combustion chamber. Cyclotherm is guaranteed to operate at minimum of 80 per cent efficiency with two passes. Bulletin also contains ratings and dimensions, general specifications.

232 THERMOSTATIC BIMETAL

W. M. Chace Co.—A 44-page illustrated booklet describes and explains twenty-six uses of the company's thermostatic bimetal as regulating, controlling or actuating elements in temperature responsive devices. Included are ten pages of engineering data for element design and selection.

233 REPRODUCTION MATERIALS

Eastman Kodak Co.—All materials available for preparation and reproduction of drawings and documents described in a booklet. A selection chart which matches originals to be reproduced with the recommended materials is included.

234 HIGH PRESSURE COMPRESSORS

Norwalk Co., Inc.—Catalog No. 44 illustrates and describes multi-stage high pressure air and gas compressors. Included are single and two stage compressors, three stage compressors, semi-portable compressors, four stage, five stage and six stage compressors, boosters and special compressors, vertical compressors, conversion tables and installations.

235 AUTOMATIC CONTROLS

Hagan Chemicals & Controls, Inc.—Bulletin GSP-901 illustrates and describes the firm's products and services. Included are brief descriptions of control systems and components for combustion control, metallurgical furnace control and aerodynamic testing control, the plant-wide water services of Hall Laboratories, the many chemical products of Calgon Co.

236 VALVELESS FILTER

Permutit Co.—Bulletin No. 4351 describes the company's automatic gravity sand filter for municipal or industrial water treatment. The unit uses no valves, pumps, or flow controllers, and is said to cost less than conventional manual filters, reduce costs of installation, operation, maintenance and expansion, and produce uniform high-quality effluent. Sizes up to 400 gpm are available.

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LATEST INDUSTRIAL LITERATURE GUIDE

237 PIPING INSULATION MANUAL

American Gilsonite Co.—A 20-page Booklet covers the methods of application of Gilsulate, a new insulation for hot underground pipes. It describes the three grades, how to determine ditch size for various pipes and types of soil, and gives sample problems.

238 FEEDWATER HEATERS

Griscom-Russell Co.—Bulletin No. 300 outlines the use of feedwater heaters, their economies and some basic functional designs. A page is devoted to a discussion of tube joint fabricating methods and the advantages of roller expanding and welding are presented.

239 LOADING ARM

Chiksan Co.—Four-page bulletin 1055-A covers hydraulically controlled marine loading arms and shows operational advantage enabling one man at a remote control point to place flange end of 8 or 10 in. aluminum loading arm aboard largest tanker. Eight-in. arm operates from 220/440 v 3 hp motor, 7.5 gpm hydraulic pump.

240 INDUSTRIAL LIQUID METERS

Neptune Meter Co.—A 28-page liquid meter bulletin, No. 566, contains selector charts which tell how to pick the right meter and register for more than 150 typical liquids. It describes the firm's Auto-Stop, repeating Auto-Stop, ticket-printing features and electric Auto-Switch for operating pumps.

241 LUBRICANT DATA

Fiske Bros. Refining Co., Lubriplate Div.—1957 edition of The Lubriplate Data Book to all who are interested in subject of proper lubrication of all types of machinery. This new Data Book is $8^1/_2 \times 11$ in. in size and contains 36 pages of valuable data pertaining to improvement of machine operation, reduction of power consumption and lowest possible maintenance costs through the use of specialized time tested lubricants.

242 GASKET MATERIAL, TEFLON

American Felt Co.—Literature describes the chemical and physical properties of Vistex with Teflon, a gasketing material. It has a tensile strength of 5000 psi, good cutting properties and is designed to resist fraying.

243 STAINLESS STEEL PIPE

Babcock & Wilcox Co., Tubular Products Div.—Bulletin TB-410 on stainless steel piping points out the comparative advantages of schedules 5, 10, 40 and 80 pipe, provides application data for seven popular grades, and explains various methods of joining, bending and welding stainless steel pipe.

244 CENTRIFUGAL PUMPS

American-Marsh Pumps, Inc.—6-page Bulletin 350 describes horizontal split case, single stage, double suction centrifugal pumps. Types HLM and HIM for wide range of capacity and head conditions. Large sectional view explains 18 important features. Specifications, performance data and dimension tables are included.

245 DEMINERALIZATION

Graver Water Conditioning Co.—Bulletin WC-111, 22 pages, covers chemical and mechanical factors entering into the design and operation of demineralizing plants for obtaining the highest quality process water and boiler feedwater from a wide range of water supplies under many different operating conditions.

246 STEAM TRAPS

V. D. Anderson Co.—Bulletin No. 657 contains specifications, capacities, sizes, pressures, weights and list prices of all principal types of Super-Silvertop traps. Construction and operating information is also included. Contains buying information on Anderson self-cleaning strainers and high-pressure steel series steam trap.

247 GASKETS METAL RASCHIG RINGS

Metallo Gasket Co.—Bulletin No. 57 describes metal and metal combined with soft packing for use on high and low pressure service, metal tower packing made as Raschig and Lessig rings. Also included are washers, shims, and metal asbestos valve disks.

248 SPEED REDUCERS

Cleveland Worm & Gear Co.—Bulletin No. 145 provides 16 pages of illustrated summary information on the complete line of gear speed reducers.

249 STEAM GENERATORS

Ames Iron Wks., Inc.—Bulletin GB-1 describes how generators have helped solve boiler room problems. The advantages of compact, simple and efficient design of complete packaged boilers are shown being put to use in plants across the nation.

250 FILTERS, FILTER ELEMENTS

Cuno Engineering Corp.—Catalogs cover Micro-Klean replaceable filter elements, Flo-Klean automatic self-cleaning wire wound filters, Poro-Klean porous stainless steel media for filtration, Micro-Klean filters for air line service, and Micro-Screen filter elements of reinforced screen mesh.

251 ALUMINUM ALLOYS

Kaiser Aluminum—A 24-page booklet offers information on mill products and services. Data is given on aluminum alloys, forms, mechanical and physical properities, applications, fabricating and finishing techniques and availability. Products include sheet, plate, foil, circles, pig, alloy ingot, rod, bar, wire, electrical conductors, forgings, extrusions, extrusion billets, roofing, siding.

252 MULTIPLIER PHOTOTUBES

Allen B. DuMont Laboratories—Catalog No. 754-MP describes function and design theory of multiplier phototubes. Description and specification of 13 phototubes are included in these 64 pages. Request on company letterhead.

253 VIBRATING CONVEYORS

Carrier Conveyor Corp.—"Natural-Frequency" vibrating conveyor Bulletin No. 112, 12 pages, describes new application of scientific natural-frequency vibrating principle as applied to Carrier vibrating conveyors with great reduction in power requirements, double capacity, and significant savings in maintenance and down-time costs. Illustrates applications for detergent powder, crushed stone, foundry sand, castings and shake-out, spiral elevating for air cooling and other drying, heating, separating and blending processes; other uses and engineering data.

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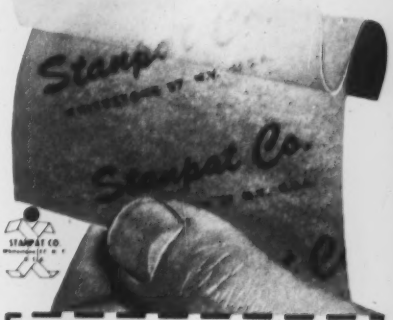

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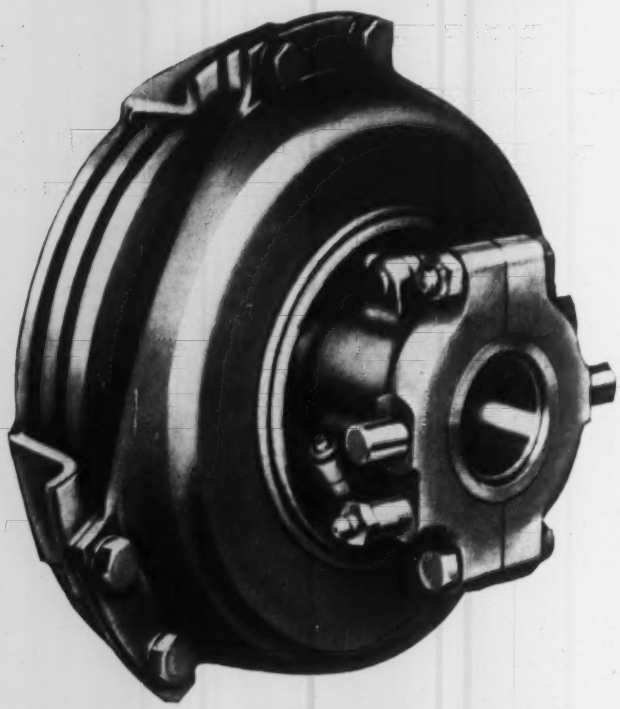

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CLUTCHES

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254 CENTRIFUGAL PUMPS

Dean Brothers Pumps Inc.—Literature describes a new line of standard, close coupled, centrifugal pumps designed to handle a wide range of general applications where conditions do not necessarily require a more costly "engineered" pump. Identified as Type "GSC," the line comprises seven pumps with capacity up to 600 gpm and total dynamic head up to 275 ft. Temperature range of liquids that can be pumped is from −40 to +250 F.

255 CONDENSER, HEAT EXCHANGER

Bridgeport Brass Co.—A 162-page illustrated handbook covers copper alloy tubes for condensers, heat exchangers, evaporators and general piping used in power plants, ships, oil refineries, chemical and petrochemical plants and process industries.

256 PLASTIC RESINS

E. I. duPont de Nemours & Co.—Catalog A-4813 illustrates and describes characteristics, forming and working techniques and end-use applications of Teflon tetrafluoroethylene resins, Zytel nylon resin, Alathon polyethylener resins and Lucite acrylic resin. Detailed properties charts are listed.

257 DUST, FUME COLLECTORS

Northern Blower Co.—Bulletin 164 describes automatic bag type arresters, diagrams standard dimension factors and supplies table of dimensions and capacities. Separate additional bulletins contain similar data for standard bag type (not automatic), hydraulic type, centrifugal type, and portable dust collectors.

258 VALVE SPECIFICATIONS

Cla-Val Co.—Catalog covers a standard line of ASA 125 and 250-lb class valves of the following types: vacuum relief, pressure relief, pressure reducing, pump control, rate of flow controller, check, remote control valves and controls, float solenoid and altitude. Catalog includes design and material specifications and list prices.

259 BLAST CLEANING UNITS

Pangborn Corp.—"Blastmaster Rotoblast Barrels" describes airless blast cleaning equipment. It illustrates from 1½ cu ft capacity to 27 cu ft. Dimensions and description of how the units work and sections on an abrading unit, an abrasive reconditioning system, construction features and the barrel's adaptation to automation are included.

260 CENTRALIZED LUBRICATION

Farval Corp.—An illustrated brochure, Bulletin No. 26, offers 20 pages of material relating to centralized systems of lubrication. The booklet discusses principles of operation, product advantages and system components.

261 RUST PREVENTION

Rust-Oleum Corp.—A general catalog contains 103 color chips showing colors available in primers, short oil type coatings, oil field finishes, restful color group finishes, machinery and implement colors, long oil type coatings, Galvinoleum coatings, heat resistant coatings, chemical resistant coatings, floor and deck coatings.

262 ALCOA HAND FORGINGS

Aluminum Co. of America—A booklet answers questions on high-strength, low-weight advantages of aluminum for parts of limited production. The booklet presents detailed discussions of factors that influence the production of a quality hand forging. Form 10595.

263 DRAFTING PAPERS—CLOTHS

Frederick Post Co.—"Tracing and Drawing Mediums," 16-page catalog, a comprehensive listing of tracing cloths, vellums, bonds, drawing papers, cross-section sheets, graph, logarithmic, record, isometric papers and cloths in roll, sheet and pad form.

264 PREFABRICATED REFRACTORY STACK

Van-Packer Co.—Four-page booklet describing the Van-Packer prefabricated refractory stack, a permanent, low cost insulated smoke stack for commercial and industrial applications. Included is a chart detailing specifications and installations data.

YOUR *New Catalogs* GUIDE

265 PUMPS

Peerless Pump Div., Food Machinery & Chemical Corp.—A 110-page catalog No. B-127, describes and illustrates line of pumps for water and process liquid handling in municipal, industrial and commercial applications. Catalog includes 20-page section of engineering information, data determinants and formulas.

266 PILOT OPERATED TEMPERATURE REGULATORS

Spence Engineering Co.—Six-page bulletin No. 1012 describes two new series of regulating valves with pilots for both fast and slow heating exchangers. Instantaneous heaters require the T134 or T124 pilot which handle heater pressures up to 50 psi. The T14 pilot is designed for slow acting heaters to take full line pressures. The T14D pilot is used when heater pressures must be limited. Selection tables and line drawings of typical applications are shown.

267 ROTARY POSITIVE GAS PUMPS

Roots Connersville Blower Div., Dresser Ind.—Bulletin 31-B-17 covers rotary positive displacement gas pumps 7 in. gear diameter and smaller. Selection tables, dimensions, performance data and illustrations for 18 standard sizes are included.

268 INSPECTION INDICATING GAGES

O-Vee Gauge Co.—Bulletin illustrates and describes new line of heavy rugged indicator gages with lever type amplification which provides greater reliability. Provision is made to enable gaging fixtures and stages to be made at low cost. Examples are illustrated in the bulletin.

269 CARBON SPECIALTIES

Morganite, Inc.—A 12-page bulletin illustrates, describes and gives design data on carbon specialties in such applications as blanks, self-lubricating bearings, valves, slides, seal noses, gland rings, piston rings and rotary vanes.

270 MATERIALS HANDLING

Jeffrey Mfg. Co.—Catalog 911 offers a comprehensive study of the broad line of foundry equipment which Jeffrey manufactures. Subdivided into four separate sections, the book contains detailed specifications and line drawings supplemented by pertinent data and installation photographs. A feature of the catalog is the new "package" sand handling system just recently introduced.

271 DROP FORGED COUPLINGS

Bonney Forge & Tool Wks.—New drop forged flats described in this bulletin are half couplings beveled for convenience, tapered for strength and ruggedness. In larger sizes, the flat Weldolet is designed to provide an integrally reinforced nozzle for vessel heads and caps.

272 VALVE COMPARISON CHART

Ohio Injector Co.—Form 1941R2 covers latest editions of new valve designs in the entire valve industry. Also listed is a valve trim comparison table.

273 COLD-ROLLED SPRING STEEL

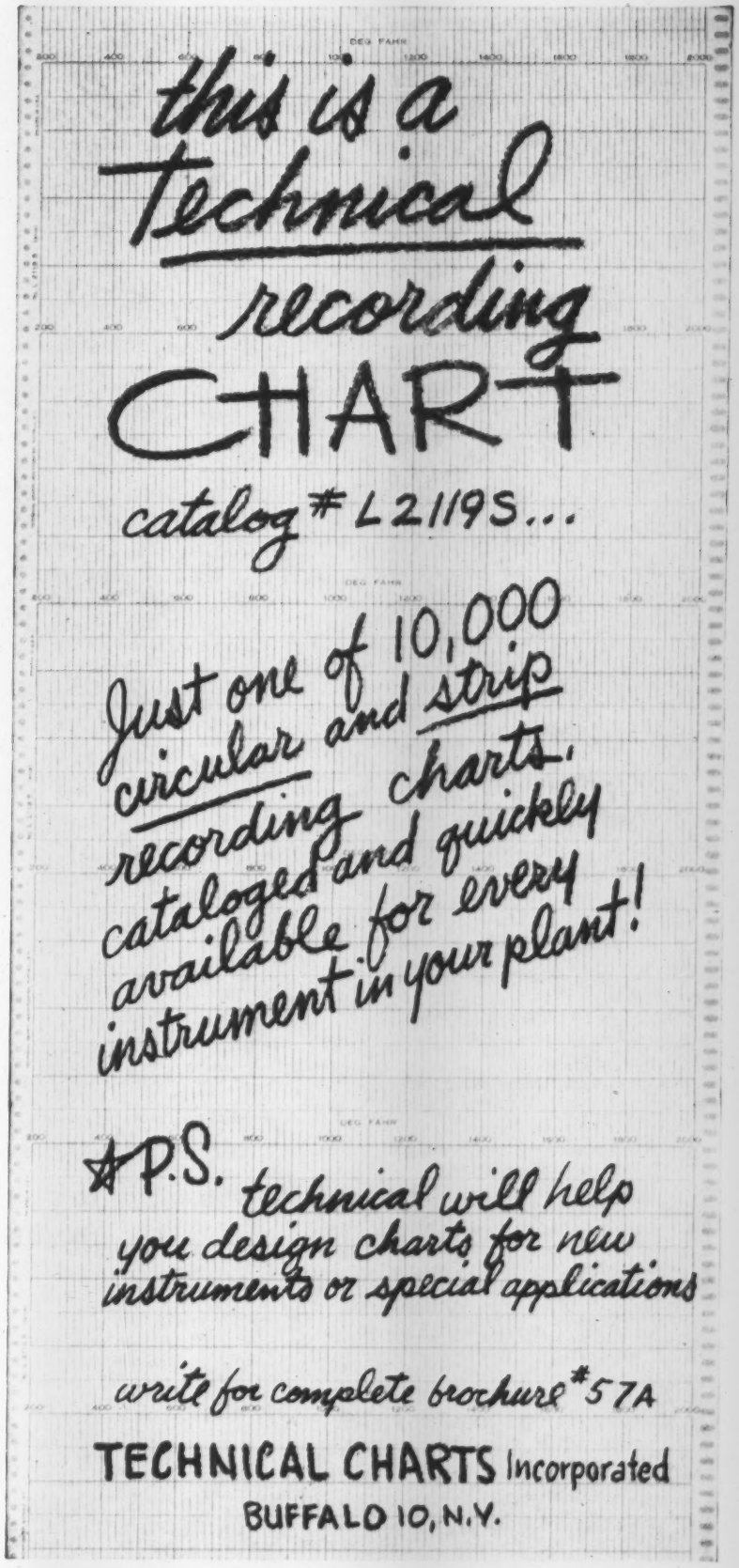
Wallace Barnes Steel Div., Associated Spring Corp.—A 48-page brochure contains sizes, grades and hardness of cold rolled spring steel and offers a general discussion of its essential qualities, what various grades are used for, how it is processed.

274 MOTOR CONTROLS

Clark Controller Co.—An 84-page catalog covers, manual and magnetic across-the-line starters, motor control centers, reduced voltage and synchronous motor starters, high voltage across-the-line starters, a-c and d-c contactors, a-c and d-c relays. Specifications and dimensions of all units are diagrammed and tabled.

LISTEN TO YOUR HEART

AND GIVE A LITTLE MORE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BUFFALO 10, N.Y.

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HEATERS

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Here is your quick, efficient and economical answer to hundreds of electrical heating problems. Clamp to metal surfaces, fit into machined grooves, cast into metals, immerse in liquids, install in ovens and ducts.

Versatile Chromalox Electric Tubular Heaters may be ordered in straight lengths or factory formed to nearly any shape required.

Select sheath metal and wattage to match your application and operating temperatures.

FREE—Send today for these 2 BIG HEATING HELPS

Catalog 50 — describes complete Chromalox line of "packaged" heaters, elements and controls.

Booklet F1550 — "101 Ways to apply Electric Heat."

C-2110-A

Edwin L. Wiegand Company
7646 Thomas Boulevard, Pittsburgh 8, Pa.

YOUR New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

275 CHART PAPERS

Technical Charts, Inc.—A revised set of "Technical Notes" includes 16 different bulletins describing specifications for standard and special recording charts. Subjects cover various types of paper available, including heat-sensitive and electro-sensitive, strip chart core and punch sizes, circular chart center punch sizes, etc.

276 TRANSMITTERS; PRESSURE AND TEMPERATURE

Republic Flow Meters Co.—Specification Folios for new line of compact Null-Balance-Vector type pneumatic instruments for utility and process control systems. Described are the VC controller, the VP Pressure Transmitter, the VDP Differential Pressure Transmitter and Temperature Transmitter.

277 WELDING NECK ANCHOR FORGING

Tube Turns—Bulletin 858 gives dimensional data and installation instructions for TUBE-TURN welding-neck anchor forging which holds pipe lines immobile even when thrust forces of over 850,000 lb are generated. For use at river crossings, compressor stations, valve and meter settings or other installations where uncontrolled thrust could damage equipment.

278 TEMPERATURE CONTROLS

Fenwal Inc.—Detailed folders describe devices for temperature detection, indication and control. Included are Thermoswitch and snap action local controls, remote bulb and capillary units, Detect-a-Fire and electronic thermistor controllers.

279 CORRUGATED ROOFING, SIDING

Philip Carey Mfg. Co.—Form 6300 illustrates corrugated asbestos-cement roofing and siding composed of Portland cement and asbestos fibres combined under pressure to form a homogeneous, monolithic sheet. The material is highly resistant to fire, acid and alkali fumes, salt air, rot proof and rodent proof. It never needs painting, but can be painted. Because deep corrugations provide beautiful shadow effects, it is often used for decorative purposes, the firm states.

280 STAINLESS STEELS

G. O. Carlson, Inc.—A four-page folder shows applications of stainless steel in plates, plate products, heads, rings, circles, forgings, flanges, bars, sheets. Products, equipment and services of the firm are discussed.

281 OPEN DIE FORGINGS

Alco Products, Inc.—A four-color, eight-page bulletin illustrates production of open die forgings in facilities expanded in 1957. Publication describes use of the firm's own steel, including new Hi-Qua-Led leaded steel, in producing forgings in various shapes and in the range of 300 to 30,000 lb.

282 TEMPERATURE INDICATING COLORS

Curtiss-Wright Corp., Research Div.—A 28-page booklet outlines details on Thermocolor pigments that indicate temperature by color change. The temperature range of 104 F to 2962 F is indicated by 36 different pigments. Twenty pigments change color once; 9, twice at successive temperatures; 5, three times; 2, four times.

283 OIL SEALS

National Seal Div., Federal-Mogul-Bower Bearings, Inc.—Oil seal catalog illustrates complete line, gives types and sizes of leather and synthetic rubber oil seals, synthetic seals with metal or rubber covered outside diameters, contains design suggestions, drafting information, application data, and installation tips.

284 POLYVINYL PRODUCTS

B. F. Goodrich Chemical Co.—A booklet gives properties and illustrates applications of Geon vinyl resins for industrial and consumer uses in extrusions, film and sheeting, molded products, expanded vinyls, coatings and rigid materials.

285 WATER COLUMNS, GAGES

Ernst Water Column & Gage Co.—Bulletin 8-1-56 illustrates and gives specifications of bronze gages, flow indicators, water columns, steel gages and valves, gage glasses and gaskets.

286 DRAWING INKS

Higgins Ink Co.—A brochure describes the firm's line of drawing inks, India inks, waterproof colored inks, art books, accessories, pen cleaner and ink assortments. Also included is a section on how to dilute inks and clean pens.

287 HEATING EQUIPMENT

Iron Fireman Mfg. Co.—A 60-page booklet covers engineering data on oil, gas and coal fired heating and power equipment. It is designed, not as a service manual, but to provide architects and engineers with information for better understanding the problems of fuel handling.

288 SERVOMECHANISM GEAR BOX

Link Aviation, Inc.—An 8-page bulletin describes the Link Hi-Precision gear box, designed for use in quality computer, servomechanism and testing equipment. Adapters and couplings are also described. The gear box is available in ratios from 10:1 to 3125:1. Size is $3^1/_8 \times 3^1/_8 \times 2^7/_{32}$ in., for all ratios. Also, 2-page bulletin describing the Link Model 013 dual output gear box.

289 VIBRATION ISOLATORS

Barry Controls, Inc.—Standard and special mounts for shock, vibration and noise control in airborne, shipboard, and vehicular installations as well as industrial machines are described in 4-page catalog keyed to supply detailed information by reference numbers. Also offers service facilities of representatives for development, test and application of vibration control.

1956 MANUAL OF CONSULTING PRACTICE FOR MECHANICAL ENGINEERS

A Guide for Consulting Engineers and Their Clients

It sets forth the proper approach in obtaining professional engineering services, in establishing the fundamental structure in engineering agreements, and in setting up conditions applicable to the conduct of engineering assignments under various types of agreements.

CONTENTS Engineer-Client Relationship. Selection of the Engineer on Merit Basis. Engineering Services (Advisory, Appraisals, Management, Production, Inspection or Testing, Design Projects). Contracts for Services. Basis for Making Charges (Annual Retainer Fees, Per Diem, Retainer Plus Per Diem, Lump-Sum, Cost Plus a Fee, Percentage of Cost of Work, Repetitive Work, Mechanical Equipment of Buildings). Principles of Settlement for Delayed or Terminated Projects. Reuse of Plans. Patents. Confidential Data. Canons of Ethics.

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YOUR

New Catalogs GUIDE

290 CENTRIFUGAL PUMPS

Pacific Pumps, Inc.—"The Choice, Design, Characteristics and Maintenance of Centrifugal Pumps" is a reprint in booklet form of three published articles.

291 FLEXIBLE COUPLINGS

Poole Foundry & Machine Co.—A 136-page manual illustrates, describes and gives engineering specification and lubrication data on flexible couplings.

292 PHOTOELASTIC POLARISCOPE

Polarizing Instrument Co.—A catalog describes four new polariscopes and two straining frames for using polaroid light control in industry.

293 STORAGE TANKS

W. E. Caldwell Co.—A 48-page catalog, No. 65, contains technical data, illustrations and price information covering metal and wood tanks with mechanical equipment and other accessories. Included are elevated and ground storage tanks, field erected, and shop built pressure and vented tanks.

294 ADJUSTABLE SPEED DRIVE

Dynamatic Div., Eaton Mfg. Co.—Bulletin FAS6 illustrates and describes the firm's fractional horsepower Ajusto-Spede drive. Fundamentals of operation, capacities, mechanical construction, optional features and controls are covered.

295 ECONOMY BOILER

Francis Economy Boilers, Div. Francis Steam Generator Co.—A 4-page bulletin illustrates and describes features of an automatic water tube boiler with fast recovery for such applications as dry cleaners, laundries, bakeries, canneries, milk product plants, dairies, wineries, bottling plants, food processors, tire retreaders, feed mills, institutions. Diagrams show a dual circulation system and a preheated feed water system, 5 to 60-hp, gas fired.

296 PLASTIC PIPE FITTINGS

Grinnell Co.—A 16-page catalog on corrosion resistant pipe fittings, flanges, valves and pipe in normal impact grade and high impact grade, rigid, unplasticized polyvinyl chloride shows characteristics, advantages and limitations. Listed are operating pressures, temperatures, applications, price comparisons, fabrication advice, installation ad supporting recommendations, dimensions and weights.

297 DIAPHRAGM VALVES

Hills-McCanna Co.—A 12-page catalog, No. 104, describes diaphragm valves in terms of their advantages, applications and specifications. The three basic types of valve operations are shown and dimensional specifications are given. Information is also included on plastic bodies.

298 SPRING WASHERS

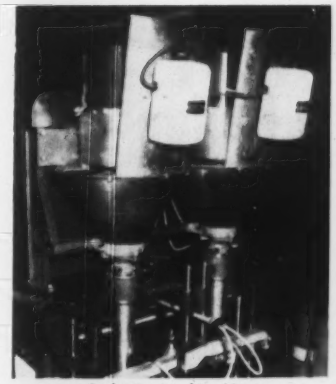
Associated Spring Corp.—A six-page brochure describes new compact energy "cartridges"—which consist of pre-assembled stacks of multiple Belleville spring washers held together by pins or rivets passing through the washers at or near their neutral axis. Exploded views show how the washers are assembled, and schematic drawings illustrate several typical applications for the cartridges.

299 FLEXIBLE, SWIVEL, SWING, AND REVOLVING JOINTS

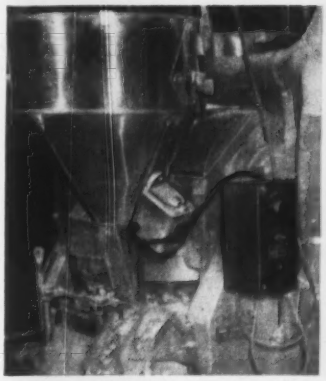
Barco Mfg. Co.—A group of catalogs cover flexible, swivel, swing, and revolving joints for piping and lines conveying steam, oil, air, gasoline, water, chemicals, including corrosive acids and alkalies, and other fluids or gases. Types cover pressures up to 750 psi, steam, and 7500 psi hydraulic. Complete range of sizes. Catalogs No. 215 "Flexible Ball Joints"; No. 265 "Rotary Swivel Joints"; No. 400 "Barco Swing Joints"; No. 310 "Revolving Joints" and No. 269 "High Pressure, Hydraulic Swivel Joints."

300 GAGES AND THERMOMETERS

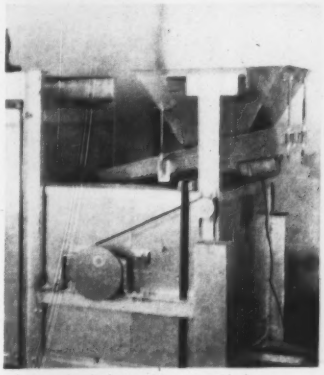
Marsh Instrument Co.—Catalogs No. 76-G and 76-T describe in detail a wide line of industrial gages, needle valves and thermometers. The catalogs are fully illustrated, including cut-away photographs and enlargements of internal parts. They cover also gage accessories, specifications including line drawings and dimensional tables, and templates covering every size and pattern.



on Packaging Machine Hoppers



on Pellet Making Machine

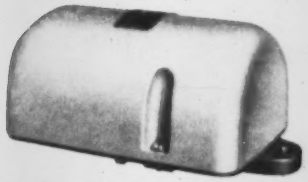


on feed chute of heat treating oven

SYNTRON

"Pulsating Magnet"

BIN VIBRATORS



Efficient, effective and versatile

SYNTRON Noiseless Bin Vibrators are compact, effective and versatile. They may be attached to a bin or hopper to eliminate materials from sticking, arching and plugging; or to chutes to keep materials moving freely; or settling and compacting materials in molds and forms. They efficiently and economically handle almost every type of material—fine powders, semi-thick liquids, granular or large chunks and lumps. Uses for SYNTRON Bin Vibrators are endless.

Instant control of their 3600 powerful vibrations per minute enables the power of vibration to be set to a point for best results. They may be manually operated or actuated by limit switches to operate with processing equipment. SYNTRON'S Bin Vibrators are efficient, long lasting and require little maintenance.

Investigate the possibility of SYNTRON Bin Vibrators in your operation. SYNTRON Bin Vibrators are available in Electric, Pneumatic or Hydraulic powered units. Write for detailed information.

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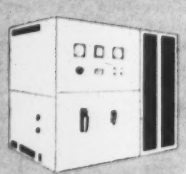
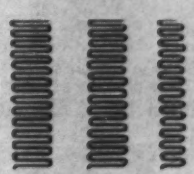
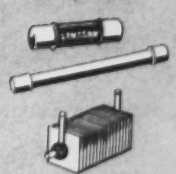


SINUATED WIRE



SELENIUM RECTIFIERS



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SYNTRON COMPANY

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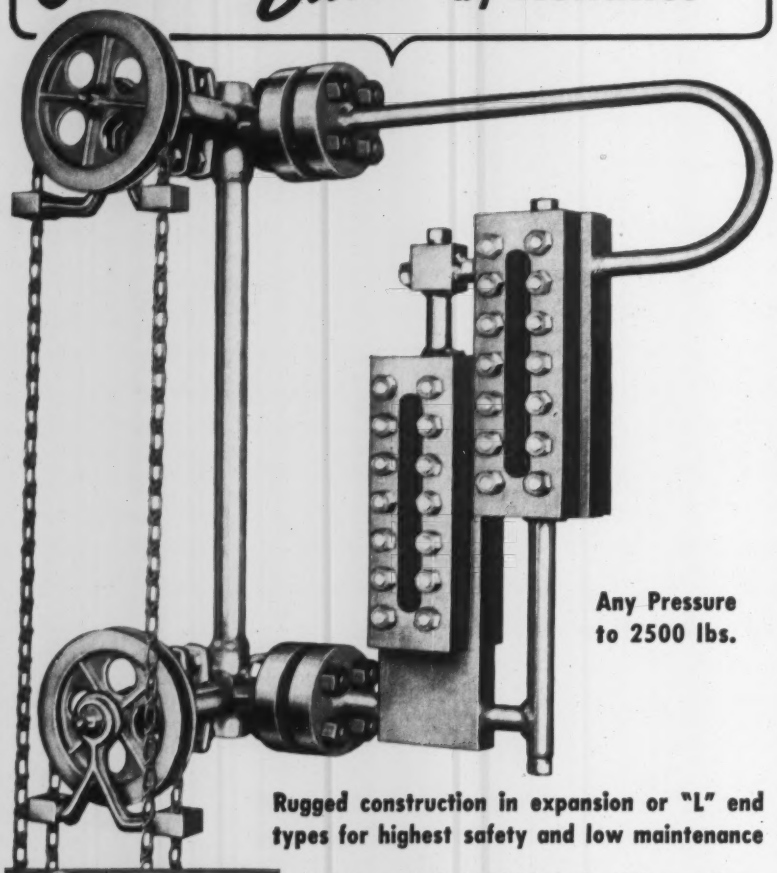
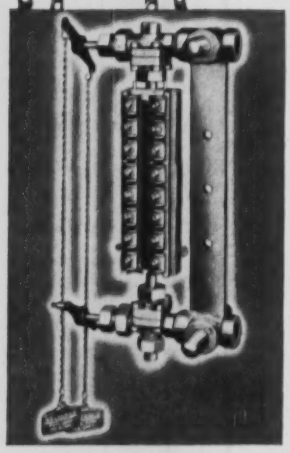
Direct-to-Drum Gage Assemblies *Custom Built* by Reliance



Any Pressure to 2500 lbs.

Rugged construction in expansion or "L" end types for highest safety and low maintenance



Made to fit individual needs, Reliance direct-to-drum assemblies meet highest engineering and construction standards. Reliance all-welded gage assemblies have more than sufficient ruggedness for severest conditions. Each unit is tested at well over 50% overload before it leaves the factory.

In the expansion tube type, a sturdy tie-tube is welded to both gage valves for rigidity between boiler connections. Gage windows are Mica-protected flat glass (to 1500 lbs.) or non-shattering Micasight — safest gage obtainable for the higher pressures. Valves — heavy duty forged steel, temperatures to 750°. Various combinations possible in other types, pressures 900 to 2500 lbs. Efficient illumination equipment available, including the powerful mercury lamp type. Write the factory or nearest Reliance Representative.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

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BOILER SAFETY DEVICES

YOUR *New Catalogs* GUIDE

301 TOOL STEELS

Crucible Steel Co. of America—A six-page index to Crucible tool steels and AISI type classifications. The cross index is an aid in making an accurate identification and selection of tool steels for specific jobs.

302 SPEED REDUCERS

Stephens-Adamson Mfg. Co.—Catalog 643 covers single and double reduction type speed reducers. Specifications and dimensions are tabled, and installation information is given. A section of the 12-page booklet deals with the firm's materials handling equipment.

303 PIPE FITTINGS, FLANGES, VALVES

Tube Turns Plastics, Inc.—Unplasticized polyvinyl chloride pipe fittings, flanges and valves are the subject of a new booklet. It discusses industrial applications of PVC piping and gives complete specifications for threaded and socket type of fittings and flanges, in both normal and high impact grades.

304 FRICTION MATERIALS

Johns-Manville—A 16-page brochure, FM-35A, gives descriptions, design data, characteristics, and a reference chart of industrial friction materials including asbestos brake blocks, linings, and clutch facings.

305 HYDRAULIC PULSATION DAMPENER

Westinghouse Air Brake Co.—A four-page catalog illustrates and describes a device that suppresses the pulsations and pressure surges which reciprocating pumps, centrifugal pumps and quick closing valves introduce into hydraulic systems.

306 DRAWING PENCIL

Venus Pen & Pencil Corp.—A technical test kit with 2 Venus drawing pencils is offered free. Lead is homogenized under the patented colloidal process to assure smoothness, no scratching, no hard spots, no soft spots.

307 DRAFTING SYSTEM

Universal Drafting Machine Corp.—Literature covers a new portable drafting system, consisting of a personal size professional drafting machine, folding drawing board, metal scales, instrument box and travel case, which can be set up on a desk in two minutes. The system, called Desk-Topper, is designed for use at home, in the office or hotel room, or on planes or trains.

Read carefully . . . select wisely, then send coupon on page 74 now for your free catalogs. Requests limited to 25 catalogs. (Sorry, no catalog distribution can be made by us to students.)

YOUR *New Catalogs* GUIDE

308 FLOW REGULATOR

Waterman Engineering Co.—An illustrated bulletin covers an adjustable flow regulator that is adapted for panel mounting on systems requiring a variable adjustment of the flow rate over a wide operating range.

309 MISSILE FABRICATION

Alco Products, Inc.—A 20-page bulletin outlines engineering and manufacturing qualifications of Alco as a missile fabricator. It lists the company's association with electronic developments, its basic research facilities, and the acceptance of its thermal engineering systems for applications, incl. the "Honest John" rocket and "Terrier" missile.

310 ELECTRIC CLUTCH

I-T-E- Circuit Breaker Co., Tranformer-Rectifier Div.—Four-page Bulletin ECP-656 illustrates and describes electro clutch developed to connect or disconnect a driven shaft or gear from a driving shaft, either running or standing still. Photos show industrial applications.

311 PROCESS HEATING EQUIPMENT

Union Iron Wks.—A four-page folder illustrates and describes vaporizers and forced circulation liquid heating and cooling units for use in the process industries. Diagrams and dimension tables of the units are included.

312 WHITEPRINT MACHINES

Ozalid Div., General Aniline & Film Corp.—Bulletin describing the specifications, advantages and features of the new Streamline 200 whiteprint machine. A table model, the Streamliner will accommodate materials of any length up to 42 in. wide and will stack materials up to 24 in. long.

313 POLYVINYL PIPE

National Tube Div., U.S. Steel Corp.—Bulletin 24 gives properties and specifications of both high-impact and normal impact polyvinyl chloride pipe. A section covers installation procedures. The chemical resistance of the plastic pipe is compared with pipe of other materials.

314 WELDING ALCOA ALUMINUM

Aluminum Co. of America—A 176-page hard cover book gives basic, practical data on the various processes for welding aluminum with special emphasis on the inert gas methods. Included is guidance in selecting the process and the alloy. One chapter is devoted to the performance of welds. The book is profusely illustrated and contains 32 tables. Form 10415.

315 OPTICAL TOOLING

Charles Bruning Co., Inc.—A bulletin illustrates the firm's optical tooling instruments and shows their application in industry. Included are alignment scopes, transits, tooling bars and stands, and accessory equipment.

316 FINISHED FORGINGS

Drop Forging Assn.—"What is a Forging?" is an eight-page folder that describes what physical changes take place when metal is transformed into a finished forging. Also described are advantages of producing metal parts by forging.

317 PUMPS AND AIR COMPRESSORS

Worthington Corp.—A 24-page brochure detailing information on Standard industrial pumps and air compressors. Also included is hydraulic data and descriptive material on Worthington steam, rotary, power, centrifugal, regenerative turbine and circulating pumps. Also included is compressed air data and material on Worthington air compressors.

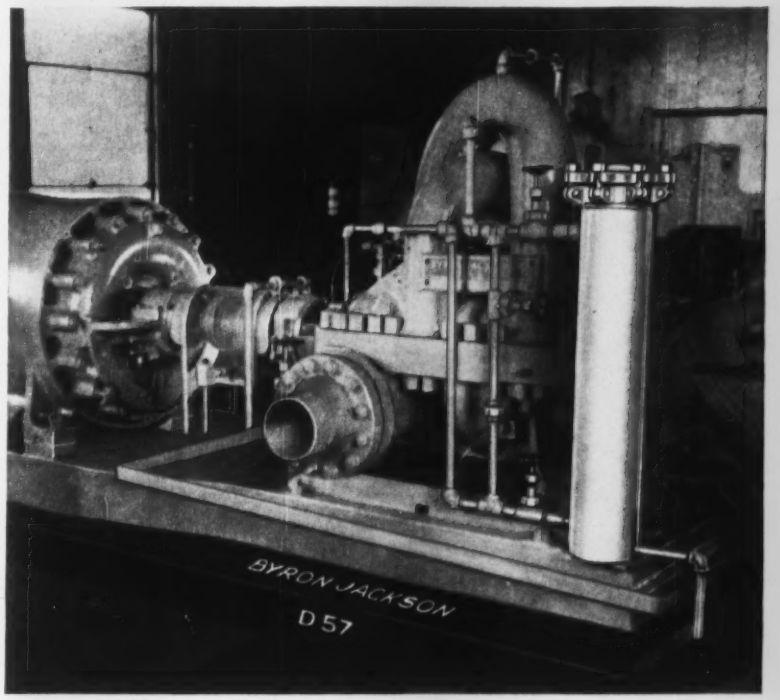
318 FIXED TYPE GAGES

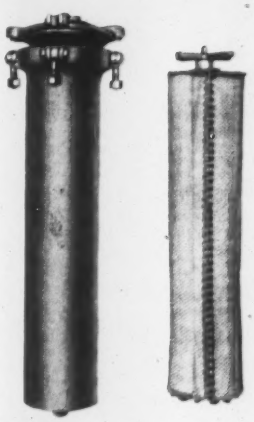
Sheffield Corp.—Catalog LTG-54, 148 pages, is composed of six sections covering the company's standard fixed type gages. A complete engineering manual for gage designers and users is included in the catalog.

319 RECORDING CHARTS

Technical Sales Corp.—Combined for the first time in one Stock List are over 12,000 Standard circular, strip, and rectangular recording charts produced by Staebler & Baker, Inc. and Technical Charts, Inc. Charts are catalogued under 92 different types of circular and 55 different types of strip recording instruments.

NUGENT FILTERS KEEP PUMP SEAL FLUID CLEAN AT PUSHBUTTON BOOSTER STATION





Nugent Fig. 1116HA-4L bag-type pressure filter of the type used to filter pump seal fluid at the Sterling City, Texas, booster station.

This Byron-Jackson centrifugal pump is in service at the Sterling City, Texas, booster station of American Oil Pipe Line Company, now owned by Service Pipe Line Company. At present, the pump is manually operated, but will be provided with microwave control from the mainline station at Colorado City, 40 miles north. At that time, Sterling will be unattended with the exception of an area supervisor at the site.

A Nugent filter on the Byron-Jackson unit protects the pump seal fluid, keeping it free of foreign matter which could cause seal leakage and eventual shutdown and lockout of the pump.

Day after day, throughout many industries, Nugent filters are performing a wide variety of filtering jobs . . . protecting valuable equipment from costly damage and materially reducing downtime.

Think it over. Can you afford to risk damage to capital equipment by failing to provide the best possible filtering protection available? Now is the time to investigate the advantages Nugent filtering offers you. Write for complete information outlining your requirements.

ESTABLISHED 1897

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OIL FILTERS • STRAINERS • TELESCOPIC OILERS
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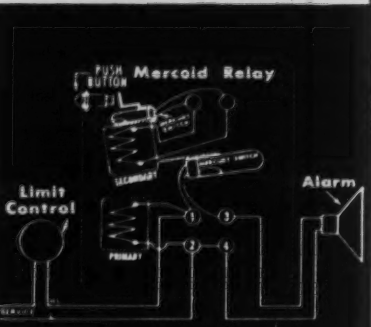
SIGHT FEED VALVES • FLOW INDICATORS

MERCOID®
MERCURY SWITCH EQUIPPED
RELAY

for Audible or Visual Alarm



The control which senses the alarm circuit is connected in series with the primary coil of the relay. The alarm control closes its circuit to supply current to the relay primary coil and through the normally closed mercury switch of the relay to the Audible or Visual Alarm. Pushing the manual button of the relay (or through a momentary contact by a remote switch connected to the pilot circuit) causes the secondary coil to move upward, opening the normally closed mercury switch and stopping the Alarm. A lock circuit in the relay holds the alarm circuit open as long as current is supplied to the primary coil of the relay. When the alarm control opens its circuit interrupting the current to the relay primary coil, the magnetic repulsion holding the relay secondary coil up is interrupted and the secondary coil drops from its own weight. The alarm circuit sequence is thus reestablished automatically and is ready for another operation at the demand of the alarm control.

Available for 115, 230 or 440V. A.C. current or similar D.C. voltages.

Our engineers are at your service—send in your control problem or

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YOUR
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GUIDE

LATEST INDUSTRIAL LITERATURE

320 O-RINGS

National Seal Div., Federal-Mogul-Bower Bearings, Inc.—This National O-Ring Catalog is designed for broadest usefulness in all types of O-ring applications. Includes practical working information about O-ring applications, sizes, groove dimensions, back-up rings, and dust seals, and lists all National O-Rings and local National Motor Bearing offices.

321 SNOW MELTING SYSTEMS

A. M. Byers Co.—A 36-page booklet describing and explaining automatic snow removal. Typical applications, installation and operational practices, coil and grid design, auxiliary units, and material selection are discussed in detail.

322 TURBINE SEAL

Koppers Company, Inc., Metal Products Div.—A 4-page folder on Huhn carbon rings for steam turbine applications discusses labyrinth, carbon garter spring ring and carbon ring sealing devices.

323 TUBE EXPANDERS

Gustav Wiedeke Co.—Catalog 81 contains specifications on the firm's line of tube expanders and cutters. Included are tables of sizes, ordering information and a list of domestic and foreign distributor locations.

324 CAST, FORGED VALVES

Edward Valves, Inc.—Condensed Catalog 105 contains data on cast and forged steel valves for a variety of applications in boiler rooms, petroleum service, industrial and technological plants. Included are Rockwell-built Mudwonder mudline valves designed primarily for mudlines in oil fields but also suitable for abrasive fluid application in industry.

325 FLEXIBLE COUPLINGS

Ajax Flexible Coupling Co.—Catalogs totaling 64 pages cover the firm's entire line of flexible couplings, including dihedral gear type with misalignment capacity up to 12 deg and rubber-bronze cushioned couplings for direct connected machines. Dimensional and capacity data is given. Catalogs describing vibrating conveyors and packers are also available.

326 HEAT EXCHANGERS

Pfaudler Co.—Manual No. 949 illustrates and describes the firm's new standardized alloy designs of shell and tube equipment for application in the chemical and food industries. This equipment may be installed for any of the following uses: condensers, heat exchangers, heaters, evaporators, coolers and reactors. Selection data, system diagrams, specifications, construction, installation, operation and maintenance information is included.

327 VENTURI TUBES

Builders-Providence, Inc., Div. B-I-F Industries, Inc.—Design features, comprehensive dimensional data, capacity tables, recovery tables on venturi tubes are included in Bulletin 110-N1A.

328 LABORATORY PRESSES

Wabash Metal Products Co.—A four-page bulletin describes the line of manually operated and powered hydraulic laboratory presses from 3 to 50 tons capacity. Heated platens, sensitive pressure and temperature gages, applications, typical uses and construction features are described.

329 MOLYBDENUM ALLOYS

Climax Molybdenum Co.—Data on molybdenum alloys and steels is contained in three bulletins. They are "Molybdenum Alloying Chart," "Super-Strength Structural Steels," and "Ultra-Strength Steels."

330 WATER WALL ARMOR

Bernitz Furnace Appliance Co.—Bulletin B-52 describes Carbofrax water wall tube armor. Installations are shown. The material can be installed in new or existing boilers without bolts or clamps to protect against mechnical and flame abrasion.

331 EXPANSION COMPENSATORS

Flexonics Corp.—Bulletin AIA No. 30-C-22 illustrates and describes expansion compensators for steam and hot water lines. Included is data on a high pressure type to 150 psi and a low pressure type to 40 psi.

332 DRAFT GAGES, INSTRUMENTS

Ellison Draft Gage Co., Inc.—Bulletin 354-A gives a briefing on the entire line of the company's bell actuated and diafram actuated draft gages, inclined tube draft gages, pitot tubes, gas analyzers, steam calorimeters and other boiler room and laboratory gages and instruments.

333 FIRED INDIRECT HEATERS

Brown Fintube Co.—Bulletin No. 551 covers the applications, advantages and types of fired indirect heaters for air, special atmospheres, corrosive and non-corrosive gases, thermal chemicals, circulating oils, asphalt, and for super heating vapors.

334 BALL THRUST BEARINGS

Gwilliam Co.—Catalog No. 28 describes, illustrates and lists standard sizes of various types of ball thrust bearings, roller thrust bearings, and journal roller bearings.

335 VALVE OPERATORS

Tork-Master Div., Harvill Corp.—A brochure on features and application of automatic valve operators shows unique, patented design, to assure low-cost installation without altering new or existing valves, and without interrupting service.

336 INTERVAL TIMERS

Cramer Controls Corp.—Four-page bulletin covers interval timers, reset timers, duplex cycle timers, time-delay controllers, cycle timers, percentage timers, running-time meters, and time totalizers. Synchronous motors and miniature d-c timing motors are also featured.

337 SPEED REDUCERS

Winsmith, Inc.—Catalog 155, 112 pages, covers more than 150 models, including the recently introduced "C" series. It contains engineering selection data and is sectionalized for quick and easy reference to all information. A special general engineering section is included to aid in solving application problems.

338 REMOTE VALVE CONTROL

Stow Mfg. Co.—A 16-page design manual covers the use of flexible shafting for remote valve control. A chart is given for the selection of the correct size shaft for any valve. Different types of end connections are shown.

339 HOSE, BELTING

Thermoid Co.—A catalog digest covers hose, conveyor and elevator belts, transmission and V-belts, sheet packing and chute lining, and friction materials. The eight-page folder is illustrated with cross sections of various hose and belting materials.

340 ULTRASONIC CLEANING

Branson Ultrasonic Corp.—Data sheet S-10 describes uses of Model AP-10-B Sonogen ultrasonic equipment for cleaning of high-speed watch movements, instrument parts, small and miniature ball bearings, electronic components, and other small, delicate, intricate mechanisms that are hard to decontaminate in any other way. Complete specifications, as well as the "how" of ultrasonic cleaning, are also given.

341 FANS, BLOWERS

Robinson Ventilating Co.—Bulletin 502 illustrates and describes fans, blowers, exhausters. Application photos are included, along with data on air properties, pressure and velocities.

342 DIAPHRAGM SEALS

Bellofram Corp.—A 16-page catalog gives basic product descriptions, applications, and operation data on diaphragm seals. Installation information, size tables, and available materials data are included.

YOUR *New Catalogs* GUIDE

343 AUTOMATIC BAR MACHINE

National Acme Co.—A 10-page Catalog illustrates and describes the new Model M single spindle automatic bar machine, a universal, fully automatic metalturning lathe which can sustain fine tolerances at the fastest speed that tungsten carbide and high speed tools can be safely operated.

344 NEW METHOD OF LUBRICATION

Stewart-Warner Corp., Alemite Div.—Catalog describes new method of lubricating industrial machinery with "Oil-Mist." Bulk of publication taken up with engineering data, covering applications, operation, bearing application, bearing speeds of this method. Also for plain bearings, selection of condensing fittings, intermixing of condensers, bearing grooving and many other engineering data appropriate to the subject.

345 OIL, GAS BURNERS

Petro—Catalog 3356 gives 20 pages of information on the selection of equipment, engineering and manufacturing factors, design and construction features, types of controls, and types and ratings of Petro packaged units for oil, gas and combination oil-gas burners.

346 LOCALIZED PLATING

Dalic Metachemical Co.—A 12-page booklet explains the process, analyzes metallurgical properties of deposits and describes engineering applications of a process of selective localized plating.

347 ULTRASONIC TESTER

Sperry Products, Inc.—An eight-page bulletin covers applications of the ultrasonic Reflectoscope for nondestructive testing of products and equipment. It explains in simplified terms the principle of ultrasonic inspection and lists the latest types of equipment available.

348 ASH SLUICING SYSTEM

United Conveyor Corp.—A four-page bulletin, No. 1S-57 describes recirculating closed circuit ash sluicing system with description of principle and sequence of operation.

349 CUSTOMIZED MOTORS

Jack & Heintz, Inc.—An eight-page booklet, "Design Your Product To Do a Job—Not to Fit a Motor," covers customized electric motors, and describes the firm's facilities for designing, testing, and producing special electric motors up to and including 3 hp.

350 THERMOCOUPLE REFERENCE JUNCTION

Pace Engineering Co.—Data sheets describe a precision and a utility series of Thermocouple Reference Junctions for multi-channel temperature measurement systems. A discussion of special circuit features and Thermocouple combinations is included, as well as specification on temperature stability and uniformity among channels.

351 SEALED BEARINGS

Stephens-Adamson Mfg. Co., Sealmaster Bearings Div.—Bulletin 455 illustrates and describes the firm's Sealmaster bearings. Standard and special units are available. Cutaway photos show such features as zone hardening, locking pin and perimeter dimple, labyrinth seal, ball retainer.

352 HYDRAULIC FLUIDS

E. F. Houghton & Co.—Folders describe a new series of fire resistant hydraulic fluids supplementing the aqueous base fluids marketed by the firm. These are phosphate ester type fluids that have been fortified by the addition of materials to increase oiliness and rust prevention.

353 CONVERTERS, INTEGRATORS AND RECORD HEADS

Librascope, Inc.—Twenty-six pages of folders showing specifications and illustrations of Librascope analog-digital converter, Librascope pressure compensated totalizing flow computer, Librascope read and record heads and the Librascope ball-disk integrator. Included also are typical applications and general engineering data.

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YOUR *New Catalogs* GUIDE

354 NUCLEAR POWER

Alco Products, Inc.—Bulletin details Alco qualifications, as builder of Army Package Power Reactor, as a supplier of nuclear power plants. Twelve-page publication includes progressive transvision of a pressurized-water reactor system identical with that in APPR, and covers company's new criticality facility.

355 TOOL STEELS

Crucible Steel Co. of America—Forty-six pages of information concerning tool steels for forging operation, the die casting process and the hot extrusion process. A series of charts detail the tool steel and heat treatments recommended for numerous forging, die casting, and extrusion operations. Also included is a brief trouble shooting guide.

356 HEAT AND POWER REFRACTORIES

Norton Co.—Thirty-two page brochure compiled for the benefit of boiler operators, setters, and engineers—to aid them in solving refractory problems and to help them obtain greater efficiency from their boilers. Also included is a temperature conversion chart, "Crystalon" brick specification tables, and a quick-figuring efficiency chart for boilers.

357 VARIABLE SPEED DRIVES

Sterling Electric Motors, Inc.—An 8-page bulletin illustrates and describes variable speed drives for metal working, mixing, pumping, materials handling and continuous processing. Engineering, selection and operating data is included. Also available is a revised price sheet.

358 AIRSTREAM CONVEYORS

Dracco Corp.—A 32-page bulletin, No. 530, contains data and 70 illustrations and diagrams explaining operation, applications, and advantages of air conveying. Practical solutions to handling problems, including automated systems, are given.

359 PANEL ENGINEERING

Leeds & Northrup—A 12-page catalog illustrates and describes design and construction of centralized control boards for steam power plants. Application photos are included along with background and photos on the company's facilities for designing and installing control units.

360 TACHOMETERS, GENERATORS

Norden-Ketay Corp.—A new line of motor tachometers and tachometer generators for use in high-accuracy computers and servo systems for guided missiles, navigation equipment, fire control, bomb directors, is described in Bulletin 423.

361 GLASS INSULATION

Pittsburgh Corning Corp.—Six specifications cover application of the firm's Foamglass insulation for industrial equipment and piping. Each booklet contains tables of suggested thicknesses of insulation to be applied, detail drawings of installation procedure, insulation supports, and recommended finishes.

362 DEAERATORS

Permutit Co.—Bulletin No. 2357 describes the company's spray type deaerating heater. The principles of deaeration and the part it plays in corrosion prevention are described and illustrated. The deaerating heater is designed to protect equipment from corrosion by removing oxygen, carbon dioxide and nitrogen.

363 BELT CARRIERS

Stephens-Adamson Mfg. Co., Standard Products Div.—Bulletin 355 lists carriers for belt conveyors and shows their application in industry. Cross sections and dimension tables are given for the various carriers.

364 FOUR-CYCLE ENGINE

Nordberg Mfg. Co.—Nordberg four-cycle diesel, Duafuel and spark ignition gas engines, ranging from 640 to 2150 hp are described in Bulletin 257. The in-line engines are built with either six or eight cylinders as supercharged; supercharged and intercooled; and Supairthermal units. Design features, dimension drawings and installation photographs are included in 16-page brochure.

YOUR

New Catalogs GUIDE

365 OIL AND GAS BURNERS

Ray Oil Burner Co.—A new illustrated 16-page catalog gives specifications and capacities of commercial and industrial gas, oil and combination gas-oil burners. It covers fully automatic, semi-automatic, and manually controlled horizontal rotary oil burners, gas burners, and combination gas-oil burners; commercial and domestic pressure-atomizing types for oil, gas, or combination gas-oil inshot gas burners; forced draft packaged burners. Tables and other technical data are included to aid in selection.

366 PACKINGS

Johns-Manville—A 12-page brochure, PK-17A, contains a packings selection chart of rod, plunger, and valve stem packings; illustrations and descriptions of precision rings, hydraulic and groove packings, oil seals, metallic and cut gaskets. Friction materials are also described.

367 AXIAL, MIXED FLOW PUMPS

C. H. Wheeler Mfg. Co., Economy Pump Div.—Horizontal and vertical axial and mixed flow pumps are described in a 12-page bulletin. Pumps are recommended for condenser circulation, primary water supply, drainage, irrigation, flood control and other applications which require large volumes of liquids containing small solids at low to medium heads.

368 COUNTING DEVICES

Veeder-Root, Inc.—Modern mechanical and electrical counters for all industrial and special counting requirements are briefly described in a four-page condensed general catalog. Also contains information on applications and how-to-order.

369 DIES, PERFORATORS

Firth Sterling, Inc.—A catalog covers the firm's line of Firthaloy dies and machinery and Diecarb perforators. The products are square and hexagon shape drawing dies; round wire, bar, and tube drawing dies; rough mandrel nibs; rough cored heading die nibs; nail and tack tooling inserts; barbing laps; straight and button head perforators; wire puller jaw inserts; die finishing equipment.

370 LIFTS

Rotary Lift Co., Div.—A 20-page booklet describing the oil-hydraulic lifting devices manufactured by Rotary. Common applications described involve moving materials between plant floor level and rail or highway carriers, from one plant floor level to another, and machine feeding. Also described is material positioning and the bridging of spur tracks.

371 TANK, VESSELS

Nooter Corp.—A 48-page Catalog No. 554 describes facilities, workscope, techniques in custom fabrication of steel and alloy plate for processing industries. Corrosion data tables for various metals are included.

372 ROLLER BEARING SEAL

Timken Roller Bearing Co.—A four page brochure describes new Duo-face seal, developed exclusively for Timken tapered roller bearings. This seal combines the features of an OD and a face-type seal and is currently available with seven sizes of bearings.

373 MOTION PICTURE CAMERAS

Wollensak Optical Co.—A catalog explaining high-speed photography, its application and the results obtainable and a folder describing the operation and uses of the Fastax high-speed motion picture-oscillographic camera are available. These cameras, used in research, design, commercial engineering, are a continuous moving film type with rotating prism positioned between the lens and the sprocket. They are available in 8, 16 and 35 mm in both 100 and 400 ft capacity.

374 ALCOA HEAT EXCHANGER TUBES

Aluminum Co. of America—Illustrated catalog contains relevant data on Alcoa aluminum heat exchanger tubes. Covers advantages, fabrication, application in petroleum and petrochemical industries, chemical, steam, atmospheric, air and gas. Also use of aluminum alloys, fluid flow characteristics, heat transfer characteristics, resistance to corrosion specifications and data with tables. Form 10186.

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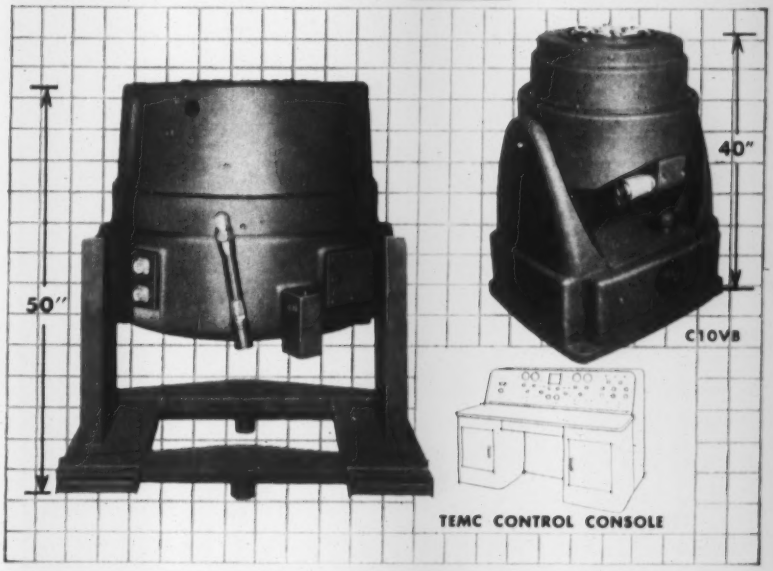

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MB C10VB System provides . . .
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Force output:	Band width:
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1050 lbs. RMS	15-2000 cps
3150 lbs. Peak	15-2000 cps

MB C25HB System provides . . .
10 "g" on table loads to 422 lbs.
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Force output:	Band width:
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REACTOR CORE - ANALYSIS

Qualifications: BS, MS in EE, ChE, Physics or Nuclear Engineering (special nuclear training desirable). 1-3 yrs. exp.

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YOUR *New Catalogs* GUIDE

375 AUTOMATIC CONTROL

Assembly Products, Inc.—Catalog 4-D illustrates and describes principles of automatic control with contact meter-relays. Included are specifications and prices on meter-relays, VHS relays, load relays and plug-in units, automatic control packages and components, panel meters, indicating pyrometers. A 6-page section of diagrams and text deals with circuitry and includes response time tables and a discussion of non-locking contacts.

376 ABUSIVE SERVICE PUMPS

Nagle Pumps, Inc.—Bulletin "H," describes the firm's new line of series "H" horizontal shaft, centrifugal pumps for corrosive and abrasive applications. Shows the three types of interchangeable casings that are available to meet varying conditions. Pictures cut away and section drawings and presents dimension table.

377 IRON SPECIFICATIONS

Gray Iron Founders' Society—A 4-page chart covers commonly used specifications for gray and ductile cast irons, giving properties, chemical composition and typical applications. Included are specifications for cast pressure pipe, soil pipe, valves and fittings. Standards, methods of testing, recommended practice and definitions are also listed.

378 REFRACTORIES

Carborundum Co.—Bi-monthly bulletins about refractories, their properties, uses and recent developments, are available. Subjects covered include muffled constructions, brickwork construction, research and development, a new silicon carbide refractory, wear resistance refractories, hot strength, heat resistance of refractories, thermal-shock resistance, chemical resistance, and stability.

379 LENSES, PRISMS

Bausch & Lomb Optical Co.—A 16-page catalog of optical parts contains information on ground glass, heat absorbing glass, retardation plates, and the firm's precision glass engraving and optical coating services. A new price list detailing up-to-date individual part prices, discount procedures, minimum ordering quantities, and terms of sale is included. Catalog L-117.

380 GEAR REDUCERS

Winsmith, Inc.—Catalog SM-57 covers new hollow shaft worm gear type reducers. The eight-page booklet contains illustrations, sizes, dimensions and engineering data on both torque arm and flange type.

381 DUST FILTERS

Koppers Company, Inc. Metal Products Div.—This 8-page brochure covers the Series 12 filter, discussing principle of automatic reverse-air jet filter cleaning and gives design features and dimensions.

382 MAGNETIC FLOW SWITCHES

Magnetrol, Inc. Literature describes flow switches in sizes from ¾ through 2 in. pipe size. Standard models are available with bronze bodies, stainless steel bodies, steel bodies, or cast iron, in either threaded or flanged connections. Switching action can be electrical or pneumatic. They use only unfailing permanent magnetic force to actuate switch mechanism.

383 SELECTOR VALVE

Republic Mfg. Co.—Catalog No. 356A illustrates and describes a 0-1000 psi pressure balanced selector valve. It is available 2-, 3- or 4-way in sizes from ⅛ to 1 in.

384 MOLYBDENUM STEELS

Climax Molybdenum Co.—Four bulletins cover technical information on molybdenum, alloys, and chemicals. They are "Molybdenum: Steels—Irons—Alloys," "Refractory Molybdenum Borides," "Refractory Molybdenum Carbides and Nitrides," and "Refractory Molybdenum Silicides."

385 COMBUSTION EQUIPMENT

Hauck Mfg. Co.—The Catalog 52 gives a condensed and pictorial review of oil and gas combustion equipment for production, construction, and maintenance applications in industry. The catalog has 12 pages and 80 illustrations.

YOUR

New Catalogs GUIDE

386 SELF-CLEANING CENTRIFUGE

Pfaudler Co.—Bulletin 946 presents information on its Titan superjector, an automatic self-cleaning centrifuge. Engineering information, specifications and application data are given, along with details on the operation of the unit.

387 FLOAT, THERMOSTATIC TRAP

Velan Valve Corp.—Catalog 600 illustrates and describes Velan monovalve float and thermostatic steam trap, a combination of the accepted float principle combined with the firm's bimetallic principle, with integral strainer, check valve and a single discharge valve instead of two or three as used in other valves.

388 MOYNO PUMPS

Robbins & Myers, Inc.—An eight-page brochure describing the history and added benefits derived from use of the Moyno pump. Phases detailed about this "progressing cavity" pump includes its principle of operation, performance, construction, capacities, and speeds.

389 CONVEYOR-ELEVATORS

Stephens-Adamson Mfg. Co.—Catalog 556-T illustrates the firm's line of conveyors, elevators. Typical arrangements are diagrammed; power requirements, specifications and installation data is given. Applications in various industries are illustrated and described.

390 JALLOY STEEL PLATE

Jones & Laughlin Steel Corp.—A 40-page booklet contains case histories of Jalloy heat treated special alloy steel plate in such uses as trailer bodies, ore chutes, shovels and dipper sticks, picking tables, structural members, hammers, grader blades, dump truck, bottom line plates.

391 DRUM AND BARREL TRUCKS

Roll-Rite Corp.—Descriptive information on the Pal-O-Matic, an ingenious device designed to accommodate all phases of manual drum handling. In addition to its other unique features the axle mount is adjustable to allow the operator to balance out the truck to suit the proportion of the load to be carried. Also included is material on the Drumatic, a standard duty barrel truck.

392 ROLL FORMED SHAPES

Roll Formed Products Co.—A 26-page catalog covers the production of roll formed shapes. Processes shown include notching, punching and cutting to length of special shapes in one continuous operation. Also included are drawings and dimensions of more than 100 simple and complex shapes.

393 PACKAGED BOILER

Preferred Utilities Mfg. Corp.—A six-page booklet illustrates and describes the design, construction and application of "Thermopak" factory-assembled, automatic oil, gas or combination fuel burning system for old or new boilers. The system's components, accessories, and piping layouts are itemized.

394 HUMIDIFICATION EQUIPMENT

Bahnson Co.—Catalog Section 104 details the firm's line of industrial humidification equipment. Information and pictures describe and show various types of steam and water humidification equipment. The different uses, capacity, function, and operation of each type is explained.

395 UNDERGROUND PIPE INSULATION

American Gilsonite Co.—A four-page Bulletin gives tips on the uses and installation of a new insulation for hot underground pipes. It explains how the material protects pipes against corrosion caused by acids and alkaline ground waters, and against bacterial action, roots and electrolysis.

396 ASBESTOS-CEMENT BOARD

Philip Carey Mfg. Co.—Form 6285 describes asbestos-cement board for exterior walls, partitions, linings, utility structures. The material is not affected by most acids, alkalis, fumes, heat, cold, weather, salt air. It is vermin and rodent proof, will not rot, rust or corrode, and needs no paint or protective coating. It can be painted for decorative purposes. Suitable for continuous temperatures up to 600 F.

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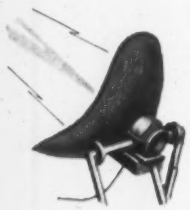

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YOUR *New Catalogs* GUIDE

397 PLATE FORM MOUNTINGS

Lord Mfg. Co.—Bulletin No. 702 contains engineering data, performance curves, specification tables, details on the design and use of plate form and multiplane mountings to control steady state vibration plus occasional shock where excellent isolation characteristics and moderate restraint are needed. Load capacities range from 1/2 to 310 lb per mounting.

398 STANDARD INDEXING MACHINE CHASSIS

Swanson-Erie Corp.—A six-page folder describes Swanson standard indexing machine chassis and accessories. Outlined are some of the over 200 standard models to suit requirements for special purpose automatic machines. Data explains how these standard machine chassis save valuable engineering time and cut building costs.

399 RECORDING SYSTEMS

Consolidated Electrodynamics Corp.—A 24-page technical bulletin, No. 1561B, covers Data tape recording and playback systems, describes the airborne and ground components, furnishes highly-technical data on the recorder along with operating information and illustrates all integral parts. Also available is a four-page technical bulletin, No. 1576, describing a new magnetic tape recorder reproducer system, showing features, applications, description, and specifications for this ground unit.

400 AIR COMPRESSORS

Gardner-Denver Co.—An eight-page bulletin illustrates and describes carbon piston horizontal single-stage air compressors for oil-free air in the processing, chemical and plastic industries.

401 BEARINGS, PARTS, FILTERS AND FRICTION UNITS

Amplex Div., Chrysler Corp.—Fifty-two page Engineering Manual containing complete details about Oilite products. Listed are Brinell and Rockwell ratings for Oilite materials. Also charted are over 1000 standard Oilite sleeves, flange and thrust bearings, cored, solid bar and plate stock—available for shipment.

402 PNEUMATIC CONVEYORS

National Conveyors Co.—Catalog P-56 shows uses of pneumatic conveyors for ash removal in steam plants; collection, processing and reclamation of cutting oils, chips, and borings in the metal working industry; and the handling of dry, pulverized or granular materials in other industry.

403 SCALES

Exact Weight Scale Co.—Seventy-two pages describing and detailing the Exact Weight Shadowgraph scale, end tower scale for production, check-weighing, batching and packaging operations; precision scales for fine production weighing; general purpose scale, fan dial scale, platform scale for production or checkweighing bags or cartons; sacking scales that sack and weigh at the same time; semi-automatic weighing machines for packaging and bagging etc., and automatic checkweighers.

404 CONTROLLED-AIR-DEVICES

Bellows Co.—Bulletins BM-25 and ML-3 illustrate and explain air motors and the choice of built-in valves and auxiliary hydraulic controls available for them. Bulletin ML-3 also describes the basic types of complete work-units, such as power feeds, work feed tables, drilling units. Both booklets contain application photographs.

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405 GLASS FIBER INSULATION

L-O-F Glass Fibers Co.—Illustrated brochures outline advantages of both Microlite and Superfine glass fiber insulations, low-density resilient insulating materials with high thermal efficiency and round absorption characteristics. They are described as being resistant to heat, fire, moisture, and corrosion and the company recommends their use in applications where the greatest thermal and acoustical efficiency is desirable in the smallest space. Tables are included on thermal and acoustical performance.

406 OIL AND GAS BOILERS

S. T. Johnson Co., Mears, Kane, Ofeldt, Inc. Div.—Bulletins 2-L, 6-H, 7-D and 4-H cover line of gas, oil and combination oil and gas fired boilers from 1 to 30 hp, with the necessary automatic boiler feeds.

407 METAL STAMPING

Bossert Div., Rockwell Spring & Axle Co.—An eight-page booklet describes Bossert's engineering and product re-design service, and illustrates complete facilities for producing large or small stampings and assemblies in any metal or alloy. A special section is devoted to illustrations of typical stampings and welded components produced for a diversified group of metal products manufacturers.

408 MULTIPORT VALVE

Hungerford & Terry, Inc.—A 16-page bulletin contains information and photographs of a poppet type multiport valve designed to operate water filters, zeolite water softeners, demineralizing equipment and other water conditioning equipment. The units work manually, semi-automatically or fully automatically.

409 FANS, VENTILATORS, BLOWERS

Peerless Electric Co.—Bulletins SDA-160, SDA-200 and SDA-220 describe the firm's line of standard fans, blowers and roof ventilators for industrial, commercial and residential use. The bulletins contain engineering data, performance tables, dimensions, ratings and specifications.

410 MOTOR CONSTRUCTION

General Electric Co.—Bulletin GEA-5980 is a 12-page publication illustrating production testing techniques and motor construction features of 1 to 5 hp dripproof and enclosed motors. The color bulletin also describes servicing and installation advantages of the complete TRI/CLAD 55 line in these ratings.

411 WATER SOFTENERS

Permutit Co.—Bulletin 2386-B describes trouble caused by using hard water. Equipment specifications, operating characteristics, data on ion exchange resins and typical installation photographs are included.

412 GLASSED STEEL

Pfaudler Co.—Bulletin 928 illustrates and describes the corrosion resistance of glassed steel to acid solutions. Resistance charts of various nitric, acetic, sulphuric, hydrochloric and phosphoric acid solutions are included in the booklet.

413 KILN INSTRUMENTATION

Leeds & Northrup Co.—A 16-page folder illustrates and describes instruments and controls for rotary kilns used in the manufacture of cement, lime and other non-metallic products. Installation photos are included.

414 BELT FEEDER

Omega Machine Co. Div., B-I-F Industries, Inc.—Design features of Model 37-20 belt type gravimetric feeder are covered in Bulletin 35-N62. Unit is designed to feed more than 3000 lb per min.

415 GAGE LABORATORY

Sheffield Corp.—Tips on setting up a gage laboratory for precise dimensional control over tools and gages used in close-tolerance production and the precision measurement services available from the Eli Whitney Metrology Laboratory including certified gage block calibration, roundness measurement, and absolute and comparative interferometry are included in Publication No. IN-1-57.

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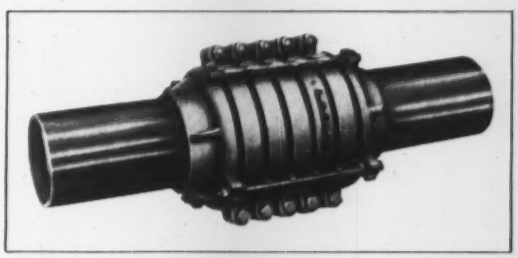

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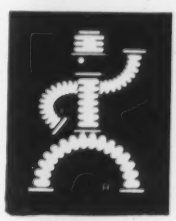

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416 BEARINGS, BUSHINGS

Cleveland Graphite Bronze Co., Div. Clevite Corp.—A 16-page Catalog gives data on engineering, material analyses and applications of bearings, bushings, wear plates, thrust bearings and related products.

417 LOCKING RING

Rosan Inc.—A catalog illustrates and describes a locking ring for inserts and studs. The principle of the unit's operation is described, and specifications of locks, inserts, studs and screws are included in the 42-page booklet.

418 GROUND FLAT STOCK

Firth Sterling Inc.—A catalog covers Invaro and Airvan grades of ground flat stock. Thicknesses, widths, and prices are given. Data on typical analysis, hardening, and quenching and tempering of the two steels is included along with tempering graphs. Authorized distributors are listed.

419 CYLINDERS, VALVES

Pathon Mfg. Co.—Bulletin 22A illustrates and describes oil hydraulic cylinders and valves. Included is information on rams, mounting brackets, and various types of cylinders and valves.

420 CONTROL ADAPTERS

F. W. Stewart Corp.—A 16-page catalog describes various adapters for use in conjunction with flexible shafting. These adapters have proven to be most advantageous for control or transfer of action from the source of power to the control unit, the firm states. Adapters pertinent to aviation, automation, electronics, machinery, radio, and other fields are described.

421 CONDUIT SYSTEM

Stillwater Clay Products Co.—Newest development in underground piping layouts, the "one over one Cert-A-Bar conduit system" is described in a one-page, illustrated information sheet. Advantages of this system in steam and condensate systems, and in high-temperature water systems are listed and explained.

422 SPRING MATERIALS

Hunter Spring Co.—A 12-page booklet discusses pricing, quoting, tolerances, tangling, packaging, spring materials with cost comparisons, quality reporting.

423 BRONZE BEARINGS

Johnson Bronze Co.—A catalog lists and illustrates more than 900 sizes cast bronze bearings, 400 sizes of bronze bars, cored and solid, graphited bronze, powdered bronze in straight, flanged and self-aligning bearings, bearing babbitt.

424 HUMIDITY CONDITIONING

Kathabar Div., Surface Combustion Corp.—An 18-page booklet shows applications of humidity control equipment in various industries. Problems, solutions and results of 12 case histories are included, along with data on how the system works.

425 UNIT STEAM GENERATOR

Preferred Utilities Mfg. Corp.—A 26-page booklet illustrates and describes the design and construction features of unit steam generators. Application photos, checklists and dimension tables are included.

426 O-RINGS

Precision Rubber Products Corp.—A 52-page handbook covers O-rings and Dynaseal packings. Included is data on the company's facilities, non-moving and moving seals, military approved O-rings, compounds, back-up rings, and seals and rings for a variety of applications.

427 MOLYBDENUM APPLICATIONS

Climax Molybdenum Co.—Three bulletins deal with "A New Look at Joining Molybdenum," "Moly Steels for Cast Gears" and "Moly-Sulfide Lubricant Additive." Advantages of the metal, engineering and metallurgical information are included in each bulletin.

428 CENTRIFUGAL CASTINGS

Sandusky Foundry & Machine Co.—Catalog No. 200 explains how the centrifugal method produces a fine-grain, dense structure free of gas bubbles, slag, and non-uniformities, with desirable physical properties for circular or symmetrical parts. The firm's facilities for producing and machining cylinders in sizes from 7 to 54 in. OD, light or heavy-walled, up to 33 ft in length, are described. Comprehensive alloy tables list characteristics of more than 70 stainless steel, steel, and nonferrous alloys available, and 86 present applications in 13 major industries are given.

429 FIRE PROTECTION

Blaw-Knox Co.—Bulletin 2426 illustrates and describes a new spray sprinkler designed to reduce fire insurance costs by 50 to 90 per cent. Applications, design and layout data on fire fighting systems is included.

430 COPPER TUBING HANGERS

Grinnell Co.—A 12-page catalog, CTH-56, cover hangers and supports for copper tubing. All hangers are copper plated and accurately sized to fit standard copper tubing. Data is also included on packaged quantities.

431 GEARS, GEAR ASSEMBLIES

Advance Gear & Machine Corp.—Catalog illustrates and explains various types of gear cutting done as well as a representative group of special gears and gear assemblies produced. All types of custom gear cutting and gear assemblies to customers' specifications as well as many assemblies of their own design are offered by the company.

432 BRONZE GLOBE VALVES

Lunkenheimer Co.—A four page, three-color detailed circular 602-2 on the two pressure classes of LQ600 bronze globe valves, for a variety of services from normal to exceptionally severe, is offered. The two pressure classes—rated at 150 lb SP, 300 lb WOG, and 200 lb SP, 550 F, 400 lb WOG—are described, and all features of each are listed. ASTM, ASME and military specification numbers of alloy for bodies and bonnets are included.

433 ROTOSTOKERS

Detroit Stoker Co.—RotoStoker Type CC (continuous cleaning)—Catalog No. 800 describes this overthrow spreader stoker with continuous cleaning grates for boiler capacities of 5000 to 75,000 lb of steam per hr—efficient, flexible, dependable—burns all grades of bituminous and lignite coals and refuse fuels—smokeless operation.

434 FRACTIONAL HP MOTORS

General Electric Co.—Bulletin GEC-1027 gives buying information on fractional horsepower general purpose and definite purpose motors and gear motors, and integral horsepower single-phase and polyphase motors and gear motors.

435 PURIFIERS, MIST EXTRACTORS, SCRUBBERS, SEPARATORS

V. D. Anderson Co.—Bulletin No. 801 itemizes principal applications of purifiers which remove liquid, solid and dust entrainment from gases and vapors. Contains buying information on internal, receiver and line type separators, mist extractors, and scrubbers. Also describes Anderson's new Quik-Flex thermostatic steam traps as well as Super-Silvertop and Heat-Kwik steam traps and Anderson strainer and float traps.

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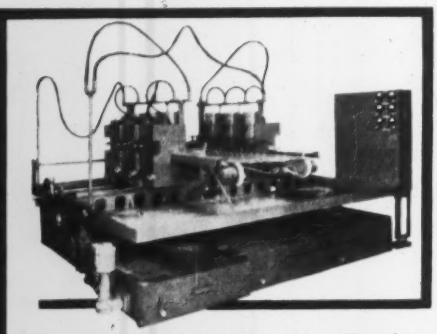

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436 SPRING DESIGN

Associated Spring Corp.—The fundamentals of spring design are set forth in an eight-page brochure. The brochure contains the basic stress and deflection formulas, the commonly used spring materials, typical applications, and certain limitations for each of the various types of springs. A tabulation of tensile, torsional and other physical properties of the commonly used spring materials, and notes on the process of manufacture and the chief uses of each is included.

437 METALLIZING APPLICATIONS

Metallizing Engineering Co., Inc.—Bulletin 51C, eight pages, gives case histories and application data on metallizing applications in production, salvage and corrosion prevention.

438 ANALOG-DIGITAL CONVERTERS

Librascope, Inc.—A six-page folder shows specifications and illustrations of converters which transfer data from shaft to code disks where non-ambiguous double brush pick-offs direct it to scan a network. Models cover 7 to 19 digits.

439 REFRACTORY GRAINS

Norton Co. A 24-page pamphlet detailing the methods whereby Norton refractory grain is produced. Also summarized are the chemical and physical characteristics, sizes available, packing methods, and the many commercial applications of refractory grain.

440 LIFTS AND JACKS, HYDRAULIC

Rotary Lift Co.—A series of folders describing a two-plunger frame pick-up lift developed for service shops plus a catalog of automatic lifts for service stations; Oildraulic transfer bridges to span the gap across spur tracks; a new Rotary truck leveler that raises or lowers trailer to dock level.

441 AERODYNAMIC RESEARCH

Hagan Chemicals & Controls, Inc.—Bulletin MSP-133 illustrates and describes the company's automatic controls for surge, altitude, mass flow, pressure, temperature position in aerodynamic research and testing applications. Application photos, diagrams and tabular summaries of the components are included in the bulletin.

442 CHROMATIC THERMOMETERS

Curtiss-Wright Corp., Research Div.—A folder describes Thermochrom colored crayons used to indicate instantaneously the temperature of hot objects. Marks made by the crayons change color at specific temperatures. Eighteen crayons indicate temperature in the 149 F to 1238 F range.

443 TRANSDUCERS

Consolidated Electrodynamics Corp. A 32-page folder, No. 1552, on transducers and associated equipment, illustrates and describes vibration pickups, velocity pickups, torsiographs, pressure pickups, dynamic pressure pickups, accessories, suggested handling and mounting methods, pressure conversion table and other data.

444 STAINLESS & HIGH ALLOY PIPE & TUBING

Trent Tube Co., Subsidiary of Crucible Steel Co. of America—A 48-page manual detailing the complete operation of Trent Tube, manufacturers of Contour Trentweld, stainless steel and high alloy pipe and tubing. Included is information on Tubing Classifications plus charts and tables applying to each class. Corrosion characteristics, weights, properties of alloys and conversion tables are also included.

445 INDUSTRIAL PLASTICS

H. N. Hartwell & Son.—Catalogs and technical bulletins describe Boltaron 6200 corrosion resistant unplasticized polyvinyl chloride sheet, pipe pipe fittings, valves, bars, blocks, and welding rod, as well as Boltaron 7200 modified high impact PVC sheet and pipe materials.

446 PISTON, SEALING RINGS

Koppers Company, Inc., Metal Products Div.—A 24-page brochure illustrates and describes American Hammered piston and sealing rings for various types of industrial applications. Engineering data, tables, and types of material are included. Also available are 4-page folders on conformable oil ring, marine piston rings, chrome plated piston rings, and piston rings for air and steam forging hammers.

447 QUICK OPENING DOORS

Struthers Wells Corp.—Bulletin SW-553 covers quick opening doors for processing equipment. Automatic or semi-automatic in operation, the units are available in Ring-lok or Wedg-lok types, designed for vulcanizers, devulcanizers, impregnators, sterilizers, cement block curing vessels, ovens, and creosoting cylinders.

448 PACKAGED STEAM GENERATORS

Superior Combustion Industries, Inc.—Packaged fire tube steam generators are described in detail and with illustration in a 16-page catalog with a special foldout cover. Data, dimensions and specifications for units in 18 sizes from 20 to 600 bhp and for operation burning oil or gas or both are included.

449 STUD WELDING

Nelson Stud Welding Div., Gregory Industries, Inc.—A manual covers designing, materials, specifications, dimensions and physical properties of the materials used in the Nelweld method of welding studs.

450 TITESEAL BROCHURE

Radiator Specialty Co.—Brochure, 12 pages, describes Titeseal Pipe-sealing Compounds and the part they are playing in American Industry. The book gives properties and recommended uses.

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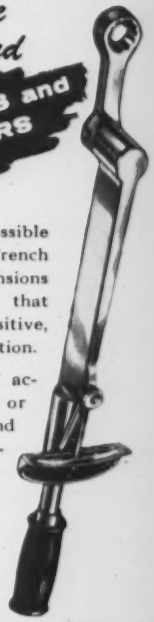

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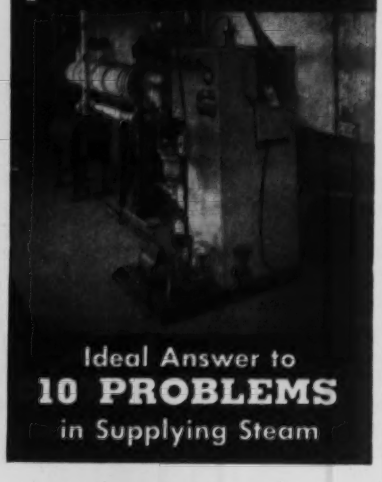

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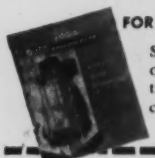

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451 HYDRAULIC MACHINERY

Watson-Stillman Press Div., Farrel-Birmingham Co.—A 24-page bulletin gives information on injection, compression, and transfer molding machines for the plastics industry; extrusion presses for ferrous and nonferrous metals; metalworking equipment; railroad shop equipment; ordnance equipment; standard and special machinery for general industrial applications.

452 DUST FILTERS

W. W. Sly Mfg. Co.—New 36-page booklet "Industrial Dust Control" describes the complete line of Sly dust filters. The booklet also includes dust filter and complete dust control systems specifications as well as extensive hopper and support data. The engineering section outlines a step-by-step procedure that can be followed in determining type and size of hooding, piping, and dust filter.

453 BELT CONVEYORS

Transall, Inc.—Four-page brochure outlining the advantages of Transall prelubricated belt conveyor idlers. A check point list is included.

454 AIR COCKS

Westinghouse Air Brake Co.—A four-page catalog illustrates and describes plug type and diaphragm type two and three-way cut-out cocks for pneumatic systems.

455 RETAINING RINGS

Waldes Kohinoor, Inc.—A new 8-page catalog supplements the company's 52-page catalog covering Waldes Truarc retaining rings. The two catalogs include 33 pages of engineering and specification charts, 6 pages of field applications and case histories, 20 pages devoted to Truarc pliers, assembly, and accessory tools, and other relevant information pertaining to the most advantageous use and selection of the rings.

456 FASTENERS

Tinnerman Products, Inc.—Bulletin 350 illustrates and describes Speed Nut fasteners. Engineering data and application information is given on spring steel fasteners. The firm's engineering and sample services are described.

457 SPRAY GUN

Metallizing Engineering Co.—Bulletin 125A illustrates and describes the firm's Type P Thermospray gun for use with alumina, zirconia, hard facing metals, stainless steels, bronze and other metals without compressed air.

458 CUSTOM GEARS

Cincinnati Gear Co.—Illustrated folder describes and shows examples of types of gears produced to individual specifications only for all types of machinery and products. Gear types listed include spur, helical, rack, worm, herringbone, bevel, spiral bevel, internal, sprocket, Zerol (R) bevel and Coniflex (R) bevel; also custom gear boxes.

459 STEEL GRATING

Blaw-Knox Co.—A 28-page bulletin illustrates and describes electroforged steel grating and treads for plants, sidewalks, stairs. A table of safe loads is included.

460 STRUCTURAL INSULATING PANELS

Philip Carey Mfg. Co.—Form No. 6301 provides data on a rigid, structural material that also insulates for walls, roof decks, partitions. It is made by bonding asbestos-cement board to both sides of a specially processed asphalt-treated insulation board. The material is described as lightweight, water-resistant, approximately 60 per cent light reflectivity, won't rust nor rot and needs no preservative treatment or painting.

461 METER TESTING

Hydraulic Products Co.—Bulletin is illustrated with installation photographs of air-water testing of gas meters ranging from five to sixty light by an air-mechanical lifting and depressing device providing multiple loading.

462 ELECTRICAL PRECIPITATORS

Research-Cottrell, Inc.—Cottrell automation system bulletin, eight pages, defines the term "Ideal Electrical Power" and demonstrates how this precipitator power level can be closely approached by automation.

463 CHUCKING MACHINES

National Acme Co.—Bulletin CM-51A illustrates and describes 4, 6 and 8 spindle chucking machines in capacities ranging from 5¼ to 12 in. Construction features shown in cutaway drawings. Specifications and dimensions are tabled.

464 VACUUM FOR INDUSTRY

Spencer Turbine Co.—Bulletin No. 155, 12 pages, on vacuum for industry contains complete descriptions of stationary and portable vacuum equipment. New features include a table for the rough calculation of the horsepower required for any specific job, and outline of the latest methods of automatic and hand dumping of refuse, a section on the application of vacuum to machine design, and illustrations of the special vacuum tools used in industry.

465 PROCESS CONTROL SYSTEM

Swartwout Co.—A bulletin covers equipment for an all-electronic control system for process and power instrumentation. It can be used with a-c, d-c or motion inputs, as well as the conventional primary elements. In addition to various components, a discussion of electronic transmission and control is included.

466 COLD ROLL FORMING

Yoder Co.—An 88-page reference manual on cold roll forming covers operating speeds, tooling, personnel training and operating techniques, surface finish, uniformity, forming of pre-coated stock, selecting proper equipment.

467 HYDRAULIC ACCUMULATORS

Industrial Hydraulic Div., Parker Appliance Co.—A 36-page catalog, No. 1530, describes line of hydraulic accumulators ranging in capacity from ten cu in. through ten gal and in ID from two in. through seven in. Included are tables giving oil volume at indicated operating pressure for each model. The book also covers adaptors and precharging accessories.

468 IRON UNIONS

Dart Union Co.—Catalog B-51 provides descriptions and specifications on malleable iron unions and union fittings with bronze-to-bronze seats and in the all-iron construction. Pressure ratings are sizes ⅛ through 2 in., 300 lb steam working pressure, sizes 2½ through 4 in., 250 lb steam working pressure, all sizes 600 lb cold water, oil or gas pressure, non-shock.

469 RADIATION TESTING

Nuclear Measurements Corp.—Complete monitoring systems for detecting, recording and warning of radioactivity in air, water or gases, is the subject of a six-page folder. The systems are designed for use wherever radioactive materials are handled.

470 CONTINUOUS BLOW-OFF SYSTEM

Cochrane Corp.—Publication No. 5700 discusses the Cochrane continuous blow-off system that assures more uniform boiler concentrates, smoother boiler conditions and cleaner steam. Several typical arrangements are illustrated in the booklet and the advantages of each are discussed.

471 RING-LOCKED FASTENERS

Rosan, Inc.—Latest edition of 44-page catalog describes and illustrates patented Rosan locking principle. It shows applications, installation and removal procedures, and furnishes design data and dimensions necessary to select and use ring-locked inserts, studs and other threaded fasteners.

472 DIRECT CONNECTED FANS

Robbins & Myers Inc.—A 12-page pamphlet summarizing the design features and component parts of the Propellair fan. Included also are pictorial descriptions of some typical installa-

YOUR *New Catalogs* GUIDE

tions. In addition performance data for Propellair axial flow fans is charted. Also described is the Sky-Blast power roof ventilator.

473 BALL BEARINGS

T. B. Wood's Sons Co.—Life-Lube bulletin No. 699 illustrates with dimensional information pillow blocks, flange units, take-up units. These standard 200 series bearings with wide inner ring, deep ball race groove are lubricated for life at the factor. They are completely self aligning. Sizes range from $\frac{1}{2}$ to $2^{15}/_{16}$ in.

474 BRIDGE RAMPS AND PALLET DOLLIES

Roll-Rite Corp.—Five pages of descriptive material on Roll-Rite standard pallet dollies, tilt steer pallet dollies and Universal reefer dollies. Also information on Roll-Rite all steel welded bridge ramps.

475 EFFECTS OF CHECK VALVES IN OVERCOMING WATER HAMMER

Williams Gauge Co.—The cause, effect, and control of water hammer in piping systems are considered in an 8-page bulletin. After describing water hammer in nontechnical terms, the brochure indicates its potential damage to piping, instruments, and other parts of water systems, and considers methods of controlling it.

476 AUDITORIUM AIR CONDITIONERS

John J. Nesbitt, Inc.—Catalog 22 illustrates and describes AudiCon air conditioner, designed especially for school auditoriums and other large assembly areas where quietness is important. Unit features silencer discharge plenum, plus return air bypass control.

477 CLUTCHES, COUPLINGS

Hilliard Corp.—Catalog MP-5 lists and illustrates a line of industrial clutches and couplings including slip clutch, over-running clutch, single revolution clutch, and automatic centrifugal coupling. Brief description of operation is a guide to suggested applications of each item.

478 MAGNETIC DRIVES

Whitney Chain Co.—Data on design, drive features, operating and performance curves, output torque rating dimensions, selection chart, as well as photographs of installations and applications of magnetic drives are included in the brochure. The new self-contained permanent magnet type magnetic drives are described as fitting new NEMA frame specifications and range in horsepower from 1 to 15.

479 ALUMINUM CASTINGS

Morris Bean & Co.—Booklet on the Antioch Process offers a brief description of the process used currently in the production of aluminum castings weighing up to 2000 lb and up to 10 ft in diameter. Loose specification sheets covering applications in aircraft, missile, electronic, and fluid flow fields are available.

480 FURNACE CONSTRUCTION

M. H. Detrick Co.—A 50-page illustrated booklet "Heat Enclosure Methods," outlines the development of furnaces and furnace construction. Suspended arch and wall construction and their application are shown for various types of units. Engineering graphs and tables are presented. Special booklets on incinerators, forge furnaces, open hearths, and industrial insulation are available.

481 TECHNICAL BOOKS AND PAPERS

The American Society of Mechanical Engineers—A 20-page Catalog describing current books, standards, codes, research reports and periodicals published by the Society and an eight-page list of available technical papers.

482 ISOLATION EFFICIENCY CURVE

Lord Mfg. Co.—Bulletin No. 901 contains a vibration isolation efficiency curve as a guide to the selection of flexible mounting systems for equipment where noise and vibration control is desirable. The curve shows, for simple linear vibration, the percentages of vibration or noise reduction obtainable with mountings of different static deflections where the disturbing frequency of the assembly is known.

ENGINEER OPPORTUNITIES AT RAYTHEON

DOPPLER NAVIGATION EQUIPMENT is readied for flight testing under operational conditions. Engineers at the Maynard Laboratory hold responsibility for program from initial study phase through prototype production.

Newly formed project groups solve complex airborne radar problems

Engineers like the project-type organization at Raytheon's Maynard Laboratory. It gives them maximum diversification in their work on the most advanced radar navigational and control problems of the day.

At Maynard, you'll find projects involving many areas of aircraft navigation and guidance systems . . . doppler navigation, velocity check systems, night-fighter operations systems, flight-control systems, altimeters. There is also interesting new work on countermeasures equipment.

Career opportunities for men at all levels now exist in the following areas:

PRODUCT DESIGN
HEAT TRANSFER
PRODUCTION ENGINEERING
METHODS & PROCESS ENGINEERING

For complete details on engineering positions in any of Maynard's project groups, please write John J. Oliver, P.O. Box 87M, Raytheon Maynard Laboratory, Maynard, Mass.

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Excellence in Electronics

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New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

483 FUEL CELL FASTENER

Waldes Kohinoor, Inc.—A 7-page catalog provides engineering data and specifications for the company's Waldes positive lock fastener, which is used to hold airplane fuel cells in place without piercing the cell wall on installation. Illustrations and charts explain the use and method of application for the device.

484 STAINLESS THERMOMETER

W. C. Dillon & Co.—Bulletin 13E illustrates and describes the company's line of calibrated instruments, including stainless steel thermometers and mounting units. Custom equipment is also described.

485 AIR DIAPHRAGM CYLINDERS

Westinghouse Air Brake Co.—A four-page catalog illustrates and describes diaphragm air cylinders and diaphragm air chambers with effective areas from 9 to 50 sq in. and strokes from 1¾ to 4 in.

486 ELECTRIC HEATERS

Edwin L. Wiegand Co.—Catalog D-52 illustrates and describes electric blower-type portable unit heaters, wall and ceiling mounted unit heaters, forced air heaters for large areas, radiant and convection comfort heaters, thermostats and contactors for commercial and industrial use.

487 PLOTTER, RECORDER

Librascope, Inc.—An eight-page bulletin illustrates and describes XY plotters and recorders for application in research facilities, computer systems, controls and data handling systems.

488 SPRAY COATING

Metallizing Engineering Co., Inc.—Bulletin 126A describes and shows typical applications of the firm's Thermospray process for hard surfacing. This entails self-fluxing, boron-silicon alloys, sprayed in powder form without compressed air, torch-fused, semi-fused or unfused to meet exact hand-surfacing requirements.

489 GROOVING TOOL

Waldes Kohinoor, Inc.—Catalog No. GT2-53 presents general information, engineering specifications, and manufacturing technical data for the Waldes Truarc grooving tool. The manual is illustrated with a number of tool setups and explains the functioning of the tool, particularly its economic performance on recessing operations. It also includes typical applications, dimensions and conversion tables, and ordering specifications.

490 WELD TUBE MILLS

Yoder Co.—A 64-page handbook describes the use of modern tube mills in the manufacture of pipe and tube. A description of the electric weld process and photos, drawings and charts on the operation, capacities, and applications of various mills are included.

491 DRAFTING AID

Stanpat Co.—Circular available describing the firm's printed adhesive-backed acetate sheets for speeding of drafting. These sheets are attached to original drawings and save draftsmen from redrawing standard details and repetitive notes. Resulting prints are clear and sharp and save tremendous amount of time.

492 ROOF VENTILATORS

Clarage Fan Co.—Bulletin 550 covers the new Centrilator, centrifugal type power roof ventilator with Jet Siphon feature for stable, high efficiency and quiet operation. Capacities and dimensions shown for 10 standard sizes. Units are constructed for static pressures to 2 in., capacities to 26,400 cfm.

493 MISSILE GROUND-HANDLING AND LAUNCHING EQUIPMENT

Loewy-Hydropress Div. Baldwin-Lima-Hamilton—Bulletin 14.004 shows the firm's activities in modern rocketry and Loewy's successful debut with a test and flight-tiring installation for Martin's satellite vehicle "Vanguard." It also describes a giant Loewy ship motion simulator for the Navy Ballistic Missile program.

494 SWIVEL JOINTS

Continental-Emsco Co.—Swivel joint catalog covers joints for use throughout the petroleum, chemical and general industry. Swivelettes are designed to provide flexibility on gasoline pump hoses, machine tool coolant lines, paint sprayers, liquid and air handling equipment at a very low cost allowing replacement rather than repair.

495 LAMINATED PLASTICS

Formica Co.—New 20-page technical catalog, Formica-4, describing the four basic services offered by the firm to industrial users of laminated plastics. Included is information on copper clad laminates, laminated plastic sheet sizes, moldings, rods, tubes, post forming, fabricating—and special Formica NEMA and special grade charts and a comparator chart.

496 AUTOMATED MINIATURIZATION

Gries Reproducer Corp.—The nine page "Small Parts for Industry" bulletin describes all 67 of the company's standard products: die-cast zinc or molded plastic components. It acquaints the potential user with the company's high-speed facilities for producing close-tolerance parts automatically. In addition to a large variety of standard products, services for molding or die-casting small parts to order, are also listed.

497 ROLLING MILLS

Loewy-Hydropress Div. Baldwin-Lima-Hamilton—Bulletin 14.003 shows some outstanding rolling mill equipment—blooming, slabbing, structural, and strip mill installations, merchant and bar mills, taper and wire-rod mills—and Loewy's large Baldwin-Lima-Hamilton shop facilities which insure fast deliveries.

498 NAMEPLATE MARKING

Jas. H. Matthews & Co.—An eight-page bulletin illustrates and describes nameplate marking equipment from steel hand stamps to production machines.

499 DYNAMOMETER

W. C. Dillon & Co.—Bulletin 1E gives data and case history information on dynamometers available with 5 or 10 in. dials, capacities from 0–500 lb up to 0–100,000 lb.

500 PIPE FABRICATION

Dravo Corp., Machinery Div.—Bulletin 1704 illustrates a part of the firm's record of engineering construction of pipeline pumping and compressor stations for the transmission and storage of gas and petroleum products.

501 LONG-TRAVEL RETRACTING SOOT BLOWER

Diamond Power Specialty Corp.—Bulletin 2111 describes new Series 300 IK long travel rectracting soot blowers, for cleaning boiler tube banks in very hot locations. Positive drive by single, enclosed air or electric motor. Improved nozzle provides better cleaning with greater economy. Positive closed pitch helical blowing pattern assures full coverage of all surface.

502 FORCED, INDUCED DRAFT FANS

Green Fuel Economizer Co., Fan Div.—The company offers four bulletins covering: (1) mechanical draft fans; (2) airfoil type fans; (3) fly ash collectors; (4) economizers.

503 AUTOMATIC VALVES CONTROLLERS

A. W. Cash Co.—An eight-page catalog, No. S-730-1, illustrates and describes 42 items including pressure reducing, regulating, control, relief and back pressure valves, controllers, differential, temperature and combination regulators, governors, control systems.

504 NEW COMPLETE PLUG GUIDE

Cannon Electric Co.—A complete 40-page plug guide describes the lines of various electrical connectors and their uses. The different connector lines or groups are shown with brief descriptions, along with the proper catalog to request for complete information pertaining to each line.

505 ROTARY STEAM JOINTS

Seamlex Co. Inc.—Bulletin 5500-A describes rotary joints with triple protection against leakage. Principal features described include external screw adjustment, floating rotary seal, pressure-equalizing chamber. The unit conveys steam, water, air and other fluids, and is made in syphon and through-flow type, pipe sizes ¼ to 2 in.

506 HEATERS

Dravo Corp.—Bulletin 552, 563 and 564 cover the firm's forced air space heaters for comfort heating, year-round ventilating, tempering make-up air, process drying, heat curing. The units are direct fired by oil, gas or combination fuels.

507 VALVE OPERATORS

Ledeen Mfg. Co.—Bulletins illustrate and describe company's line of pneumatically or hydraulically operated valve operators for direct or remote control of gate, diaphragm and plug valves. Selection information, torque ratings, dimensions, and weights are given.

508 AIR CLEANING EQUIPMENT

Green Fuel Economizer Co., Fan Div. The company offers three bulletins covering: (1) Aerodyne industrial dust collectors; (2) Aerodyne packaged dust collectors; (3) Sure seal air filters.

Read the various items listed . . . one catalog may hold the solution to your present problem . . . and select those of interest to you. *Distribution by us to Students is not included.* The coupon on page 74 must be mailed on or before December 15th.

YOUR *New Catalogs* GUIDE

509 DRAFTING EQUIPMENT

A. W. Faber-Castell Pencil Co.—The company offers three bulletins outlining some of their drafting materials. Described in detail are the Castell slide rules and scales as well as the Locktite Fleetline Holder, guaranteed dust-free because there is no sharpening or sanding. In addition Faber-Castell has available a pocket catalog for quick reference.

510 VALVES

Ledeen Mfg. Co.—A 16-page bulletin illustrates and describes the company's line of hand, foot, power and solenoid operated valves, air, oil, gas or water powered. Bulletin gives operating and flow cycles, dimensions and weights. Circuit diagrams, parts and accessories are included.

511 SHORT RETRACTING SOOT BLOWER

Diamond Power Specialty Corp.—Bulletin 1079A describes improved Model IR short retracting soot blower for cleaning water cooled boiler furnace walls, hopper slopes or narrow portions of tube banks adjacent to walls. Operates in extremely hot zones. Air motor, electric motor or manual operation. Automatic cycle.

512 MECHANICAL CONSTRUCTION

Dravo Corp., Machinery Div.—"Engineering Constructors," catalog No. 1200, describes the company's mechanical construction services. Prepared as a photographic story, the book shows typical examples of construction projects completed for steel mills, chemical plants, water works and the petroleum industry. Introduction explains how a staff of experienced engineering-construction specialists are equipped to consummate any type of working contract.

513 INDUSTRIAL WIRED TELEVISION

Diamond Power Specialty Corp.—Bulletin 2140 describes Model 500 Closed Circuit Television Camera System, compact and complete for industrial use. Picture of gages, instruments, conveyors, remote gates, furnaces etc. viewed on cable connected standard TV receiver or UtiliVue Monitor. Camera is self adjusting to compensate for wide variations in scene brightness. Weatherproof housings available for outdoor use.

514 GRATINGS, STAIR TREADS

Dravo Corp., Machinery Div.—Bulletin 1105 illustrates and describes aluminum, diagonal, radial, rectangular and serrated grating, stair treads, and special metals, fasteners, and construction of these units for industry. Selection and application information is included.

515 CYLINDERS

Ledeen Mfg. Co.—A 12-page bulletin illustrates and describes the company's line of cylinders for air, oil, water, gas or steam operation in medium, heavy and super-duty construction. Selection information, ratings and limitations, and rod and head attachments are included.

516 TEST BOILERS

Besler Corp.—A four-page folder covers features and advantages of high temperature, high pressure test boilers, designed to deliver steam up to 3000 psi and 1100 F. Units deliver steam within several minutes from cold start. One of the models handles loads from 500 to 15,000 lb/hr.

517 SPUN STEEL TUBING

American Cast Iron Pipe Co.—Illustrated 64-page catalog describes special products division facilities, the centrifugal spinning process, its advantages and illustrates versatility of application of tubes. It contains tables, technical data, engineering information for stainless and carbon steel tubes 2.25-50 in. OD.

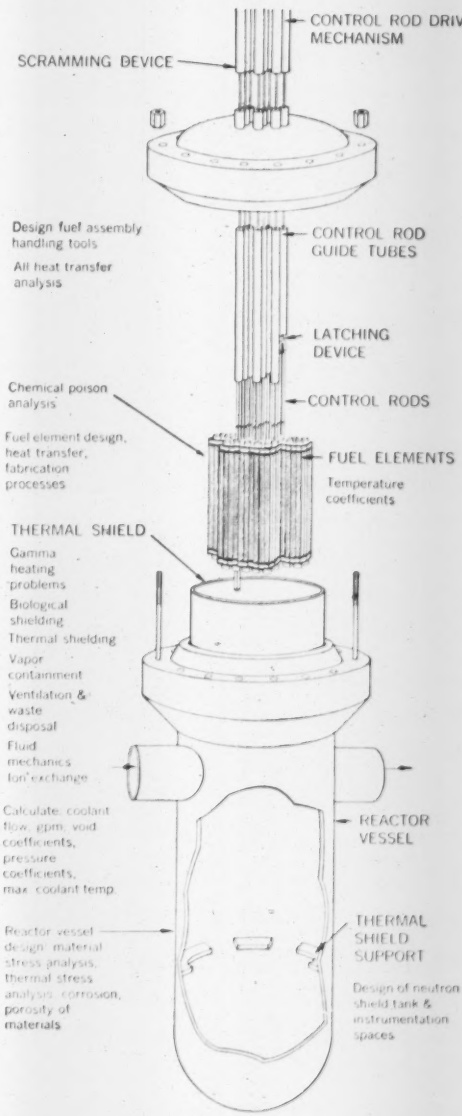
518 PIPING DESIGN

Blaw-Knox Co., Power Piping and Sprinkler Div.—The design of piping for flexibility with Flex-Anal Charts is covered in an 86-page book. It fills the need for the flexibility analysis of any piping system. It is intended for the experienced pipe designer who can, by use of this method and the application of Flex-Anal Charts, accurately analyze most piping systems in a few hours which formerly required days, even weeks.

CHEMICAL, MECHANICAL, NUCLEAR ENGINEERS

WESTINGHOUSE COMMERCIAL ATOMIC POWER COMES OF AGE

Where would you work on an atomic power reactor?


CONTROL ROD DRIVE MECHANISM
SCRAMMING DEVICE
Design fuel assembly handling tools
All heat transfer analysis
CONTROL ROD GUIDE TUBES
LATCHING DEVICE
Chemical poison analysis
CONTROL RODS
Fuel element design, heat transfer, fabrication processes
FUEL ELEMENTS
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THERMAL SHIELD
Gamma heating problems
Biological shielding
Thermal shielding
Vapor containment
Ventilation & waste disposal
Fluid mechanics Ion exchange
Calculate: coolant flow, gpm, void coefficients, pressure coefficients, max. coolant temp.
REACTOR VESSEL
Reactor vessel design, material stress analysis, thermal stress analysis, corrosion, porosity of materials
THERMAL SHIELD SUPPORT
Design of neutron shield tank & instrumentation spaces

This diagram shows the main parts of a pressurized water atomic power reactor, one of many types being designed at Westinghouse Atomic Power Department . . . and just what work would be done by you in the commercial atomic power industry. There are many overall studies on which you may work, as well as specific studies.

5 Commercial Atomic Power Programs Now Under Way

1. A 150-megawatt homogeneous reactor for Pennsylvania Power & Light Co.
2. The first industry-owned testing reactor for nuclear-materials study (Owned by Westinghouse).
3. A 134-megawatt reactor for Yankee Atomic Electric Co.
4. A 134-megawatt atomic plant for Edison-Volta, Italy.
5. An 11.5-megawatt pressurized water reactor for Belgium.

Also research, analysis, and development of advanced reactor types . . . and more programs, national and international, are coming in.

Immediate openings in the Pittsburgh area for: Chemical Engineers. Mechanical Engineers. Nuclear Engineers. Metallurgists. Physicists. Ceramists. Chemists. Instrumentation & Control Engineers. Atomic experience desirable but not necessary . . . we're not dependent on government subsidy . . . opportunities for advanced study on company fellowships.

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New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

519 SURFACE CONDENSERS

Worthington Corp.—Bulletin W-200-B3A shows applications of surface condensers for steam power stations, industrial processes, marine and water works service.

520 MINIATURE MECHANICAL CHAIN

Sierra Engineering Co.—Catalog describes miniature mechanical chain and sprockets, gives engineering data on chain which operates smoothly around a 7-tooth sprocket with a root diameter of .250 in. and has a pitch of .1475 in. The unit is for use where precise motion control is needed in miniature assemblies, especially where motion is to be transferred through several planes simultaneously.

521 AUTOMATIC VALVES

A. W. Cash Valve Mfg. Corp.—An 82-page catalog describes and illustrates line of pressure reducing and regulating valves, relief valves, back pressure valves, hot water boiler control valves, anti-siphon vacuum valves, and strainers. Contains seven new items not previously included in former catalogs.

522 MULTIPORT VALVES

Cochrane Corp.—Publication No. 5227 on the Cochrane multiport valve gives application, styles, sizes and the general theory of multiport relief operation. The back page of the bulletin is entirely occupied by tables to facilitate ordering.

523 NICKEL ALLOYS

International Nickel Co.—"Standard Alloys for Special Problems" describes 18 Inco nickel alloys in problem-solving applications to help in selecting most suitable alloy for specific service conditions such as corrosion or heat resistance. Booklet also discusses Inco welding materials, sand and precision castings, as well as giving average properties and available forms of Inco nickel alloys.

524 MOTOR REDUCER

Falk Corp.—Offers a revised Motoreducer Bulletin 3100, and a completely new Shaft Mounted Drive Bulletin 7100. Both are illustrated and contain complete information on types, sizes, horsepower, selection tables, dimensions, applications, accessories . . . and more.

525 UNDERGROUND PIPE INSULATION

Zonolite Co., Z-Crete Div.—A 12-page brochure gives data, drawings, typical installations on Z-Crete, a monolithic, cast-in-place underground insulation.

526 MOTORS, DRIVES AND REGULATORS

Reliance Electric & Engineering Co.—Three bulletins detailing Reliance totally-protected motors; Reeves adjustable-speed drives and speed controls from 1/3 through 87 hp and the Reliance VSMR mill regulator, an electronic regulator for continuous process industries. Included is a brief catalog of Reliance motors and Reeves drives.

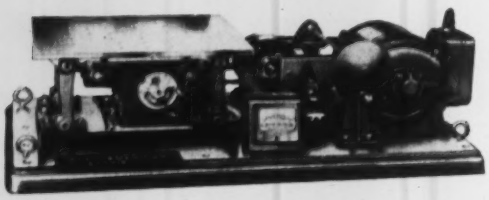
527 TITANIUM FACT FILE

Mallory-Sharon Titanium Corp.—Now available, a 24-page "Fact File" on titanium as a reference piece for national design and production engineers. The booklet includes key data on titanium's advantages; physical, mechanical and corrosion properties; metallurgical; machining; as well as production information on machining forming and welding.

Your NEW CATALOGS Guide offers readers of MECHANICAL ENGINEERING an opportunity to secure advertisers' latest industrial literature available. In this issue there are 527 items to make selections from. For convenience an index may be found on pages 73, 74 and 75. Select desired catalogs by number, requests limited to 25 catalogs. Fill in coupon on page 74 and mail promptly. (*Must be mailed on or before date given on coupon.*)

Use This Free Literature Service--*Mail The COUPON Today*

Parts, Assemblies, Up to 150 lbs. Given Vibration Fatigue Test on the ALL AMERICAN Model 150 HLA-D



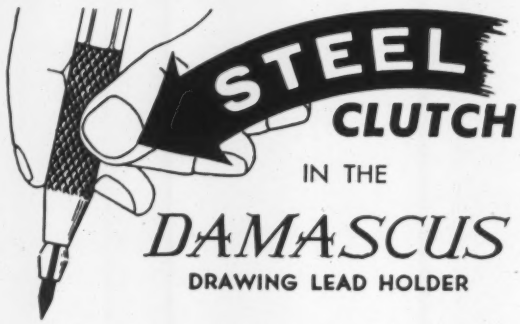
This machine, subjects parts or assemblies, up to 150 lbs. in weight, to a comprehensive vibration fatigue test. It has a 50% overload safety factor. Vibration in simple harmonic motion is produced horizontally. Displacement (double amplitude) is adjustable from 0" to .125". Automatic Range Selector controls acceleration and deceleration. From 10 cycles per second frequency may be increased uniformly to 60 c.p.s. and then decreased to 10 c.p.s. Any desired range within the total may be selected. Selector can be switched off and frequency held at any c.p.s.

Recommended for testing aircraft, electronic, electrical, mechanical or optical parts or components. One of 10 models. Send for Catalog F, containing helpful data, nomograph chart and listing typical users. Write to

ALL AMERICAN TOOL & MFG. CO.

8019 LAWNDALE AVENUE, SKOKIE, ILLINOIS

Makers of All American Precision Die Filing Machines



Balance is in the knurled finger grip for effortless pencil control.

Hardened steel spring loaded clutch grips lead securely — will last for years.

$1.85

Push button anodized red, blue or yellow for quick identification.

Ask your supply house or write for descriptive folder and name of nearest distributor.

RICHARD BEST PENCIL COMPANY
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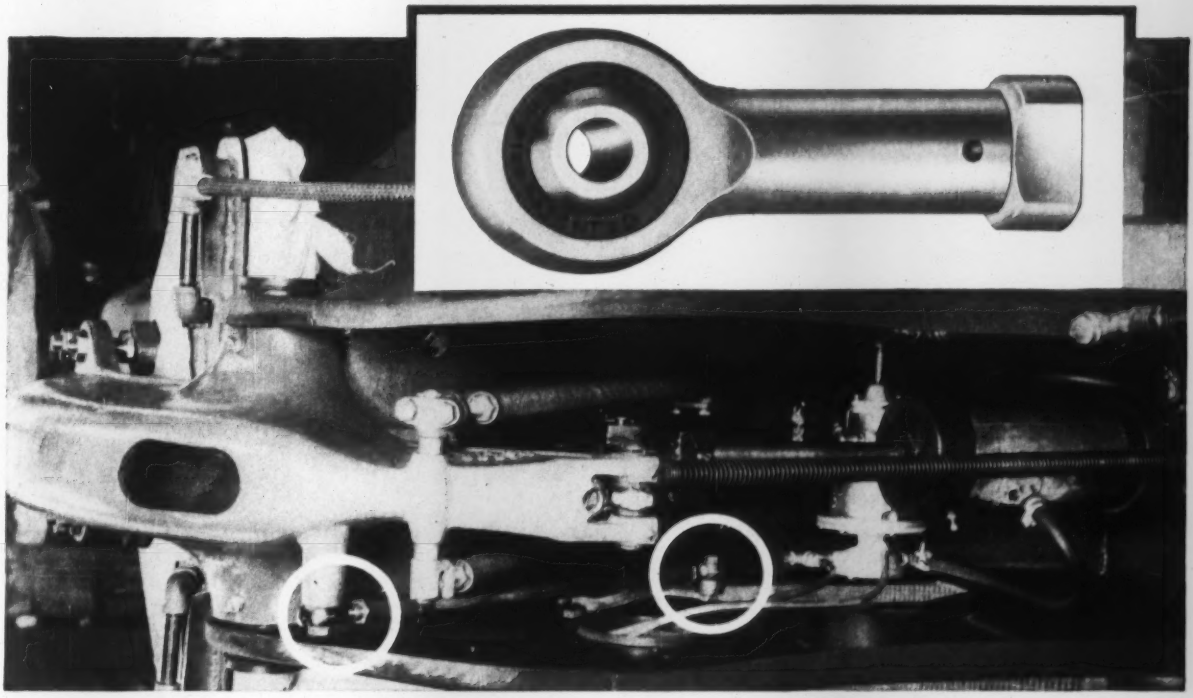
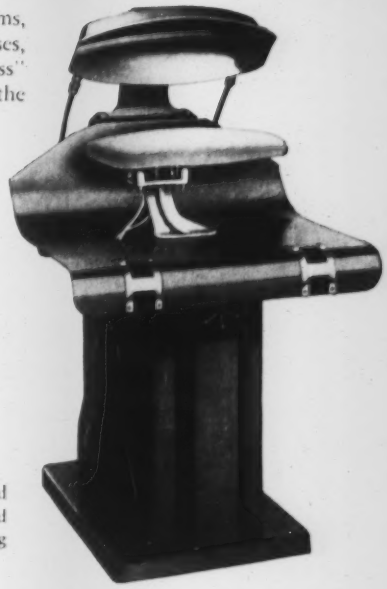
. . . For Ease of Mounting . . . choose . . .

HEIM Spherical Bearing Rod Ends



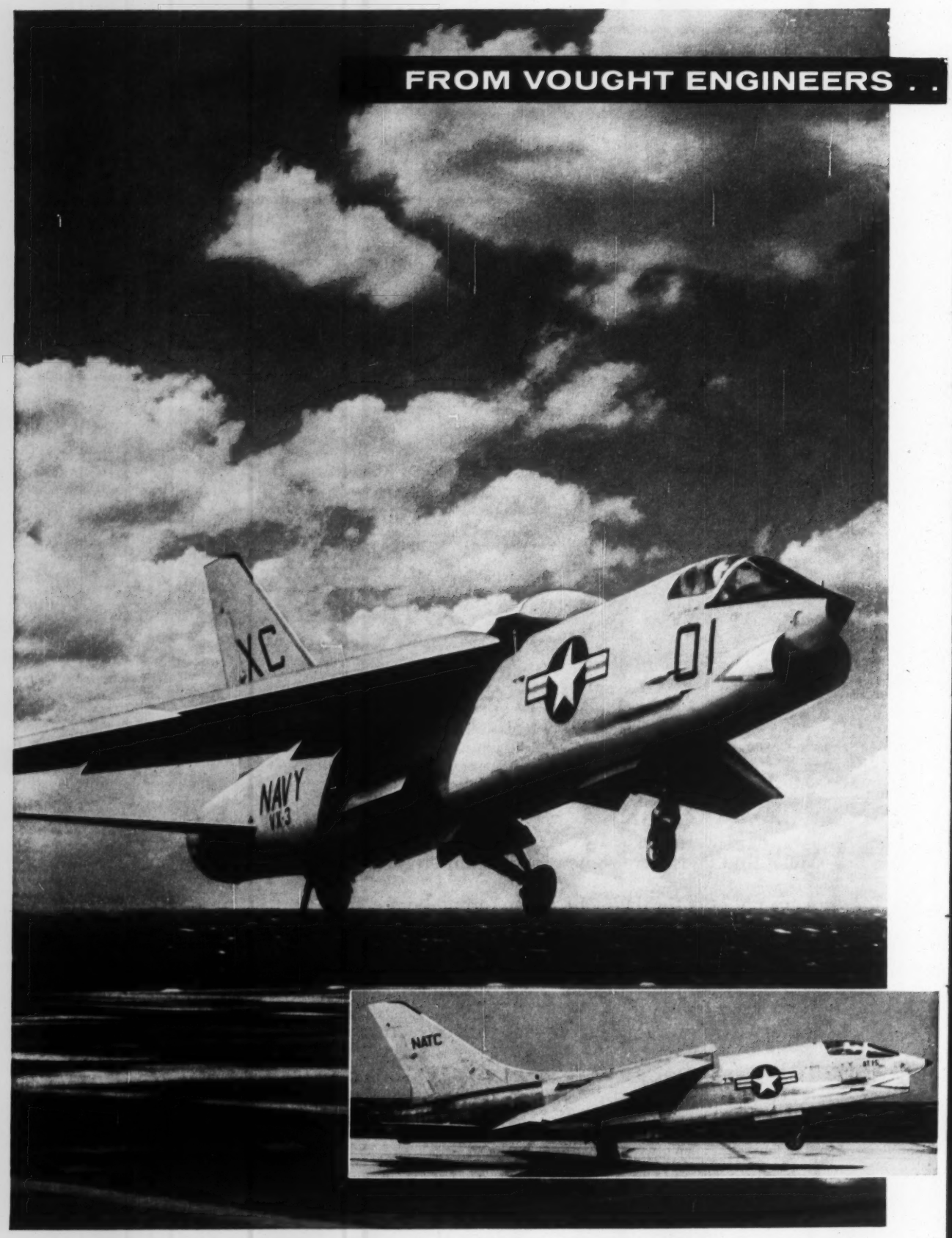
Designed for general use in pressing the more difficult small lays on uniforms, smocks, and house dresses, and for finishing small garments such as shorts, blouses, and children's dresses, the "Prosperity Utility Oval Shaper with Square Ends Press" uses Heim Rod Ends as the end members of the connecting link between the hydraulic check and other operating parts.



Heim Rod Ends were chosen for this important linkage not only for their ease of mounting, but because their self-aligning feature was required to compensate for the hydraulic check link and the operating levers swinging out of plane with each other.

To familiarize prospective users of Heim Spherical Bearings and Rod Ends with the unique, single ball construction, we would like to mail you a free sample. Or write for the complete catalog of Heim Bearings.

THE HEIM COMPANY FAIRFIELD, CONNECTICUT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XC
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NAVY
VX-3
NATC

. . NEW SPEED, NEW SAFETY IN A HINGED WING

Profile of a New Approach to a Carrier Landing

As he whistles in for a carrier landing, the Crusader pilot has the full forward visibility he so vitally needs.

Up above the cirrus, he has the slashing, 1,000-mph-plus speed that assures air superiority.

By all that governs carrier fighter design, he should be entitled only to *one or the other* of these two features. But Vought engineers conceived a variable incidence wing which enables the Crusader to give him both.

They developed a continuous wing, attached to the Crusader fuselage by pivot lugs at the trailing edge and by a hydraulic strut near the leading edge. Prior to landing, the wing may be tilted into desired approach attitude. The fuselage, meantime, remains almost horizon-level and the pilot has a straight-on view of landing signals and the oncoming deck.

By achieving full approach visibility without elevating the pilot seat, Vought engineers have kept the Crusader canopy small, simple, sleek. This minimizes fuselage drag, and is a major factor in the Crusader's Thompson Trophy-winning speed.

Typically, the Crusader's developers approached their assignment with firsthand operations analysis, completed it with technical free-thinking. Again, they came up with an original weapon . . . and an important new concept as well.

Weapon System Development at Vought

Successful weapon systems and well-rounded engineers have a common denominator at Vought. It's the "project-group" system, a highly effective brand of development teamwork that makes each engineer an inside man in the over-all development picture.

On the *Crusader* fighter, the system worked like this:

Engineers selected from their home groups for the *Crusader* project followed their assigned systems and subassemblies from preliminary design to flight test. Teamed with engineers from other groups, they gave mutual assistance and enlarged their own view of the program.

At the same time, liaison was maintained with the home groups on methods, research and policy. This way, the state of the art was coordinated with the practical problems of project work. Engineers of one specialty, working with those of another, reached better compromises, developed a wider view.

Whether you are an experienced project man, a technical specialist, or a junior engineer, you, too, will appreciate project-group advantages.

Turn tax savings into buying power

You can do it in Dallas where there's no state income tax, no local or state sales taxes. Low school and property levies and a favorable cost of living add to your savings, or your budget for fun.

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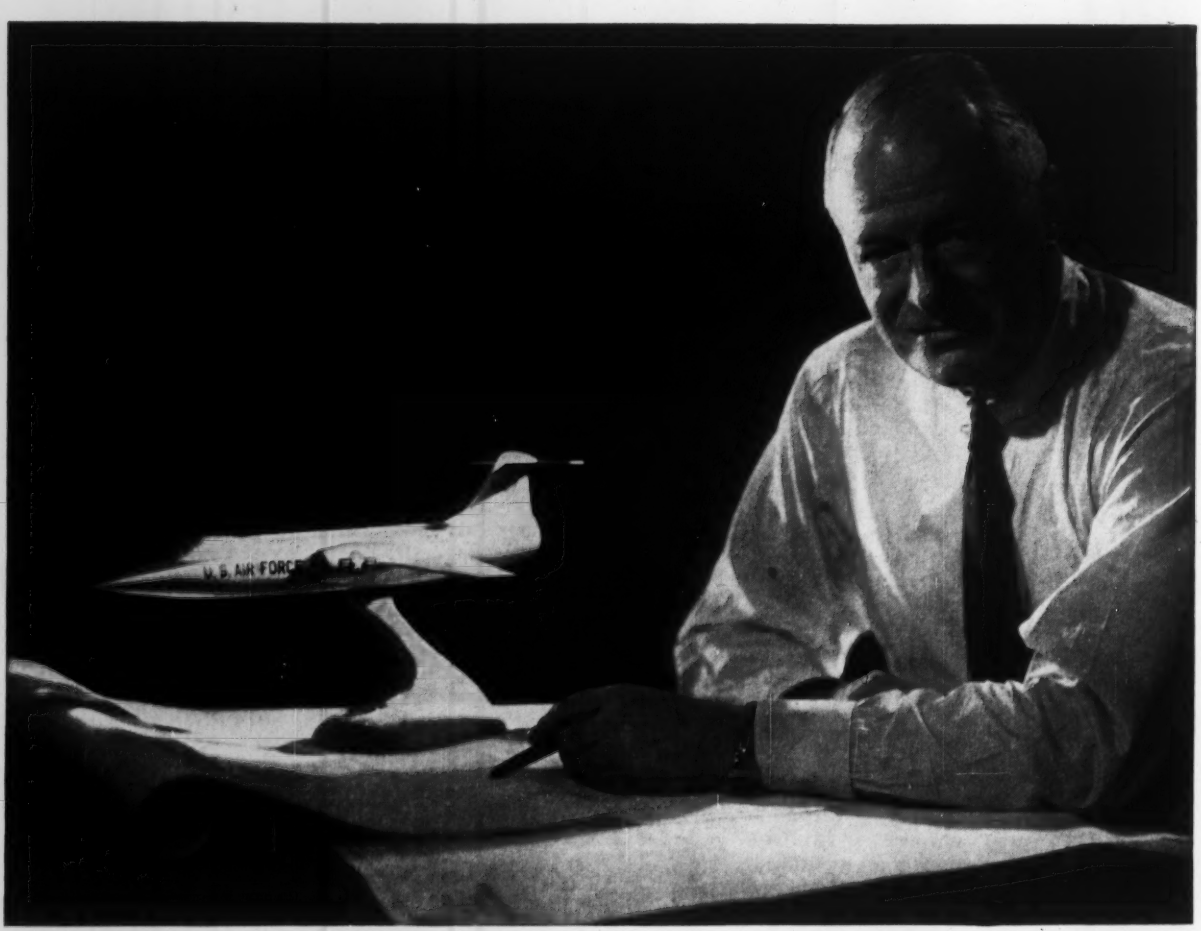

ROBERT E. GROSS

Portrait by Fabian Bachrach

34,500 Lockheed Employees Regularly Buy U.S. Savings Bonds

"We in the Lockheed Aircraft Corporation family are proud of our record of participation in the U.S. Treasury's Payroll Savings Plan.

"It is important . . . particularly in these times . . . for all Americans to support our nation's programs and policies in every way. I know of no better way than the regular purchase of Savings Bonds.

"Our records show Bond-buying employees are saving at the weekly rate of $165,000 . . . a yearly total of approximately $9,000,000.

"This thrift, practiced regularly, is a vital keystone in building family security. It also makes a significant contribution to stabilization of the purchasing power of the dollar and the prevention of inflation.

"Each of our new employees is given the opportunity to join his fellow workers in the Payroll Savings Plan. We feel this is an important step in insuring America's future security and prosperity."

ROBERT E. GROSS, ***Chief Executive Officer, Chairman of the Board, Lockheed Aircraft Corporation***

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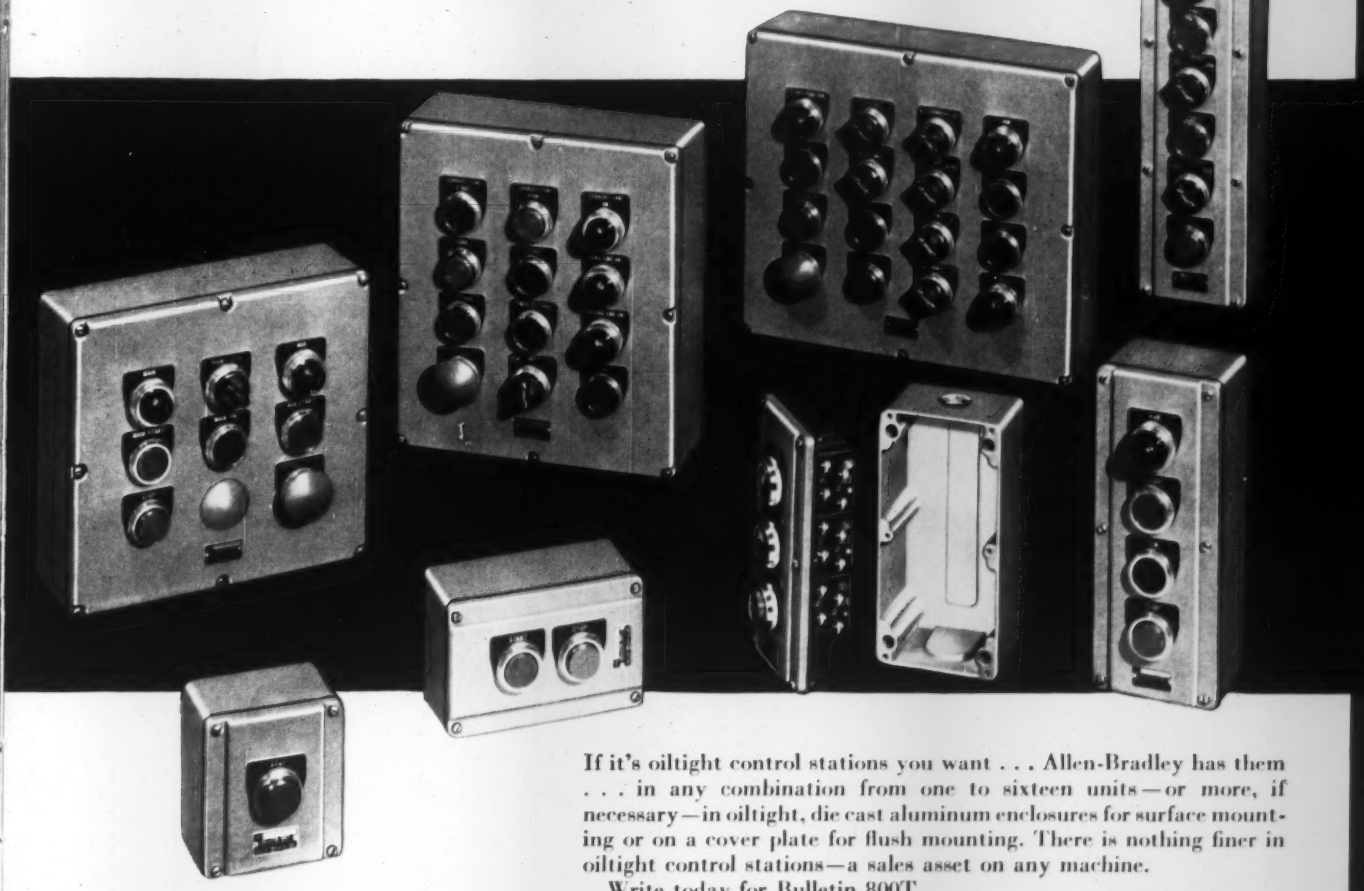
MECHANICAL ENGINEERING

NOTHING FINER IN oiltight control stations

BULLETIN 800T

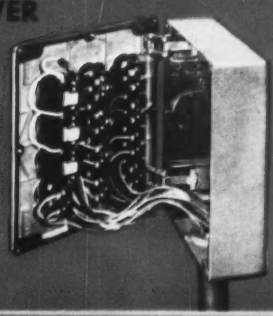


If it's oiltight control stations you want . . . Allen-Bradley has them . . . in any combination from one to sixteen units—or more, if necessary—in oiltight, die cast aluminum enclosures for surface mounting or on a cover plate for flush mounting. There is nothing finer in oiltight control stations—a sales asset on any machine.

Write today for Bulletin 800T.

HINGED COVER

The 9, 12, and 16-unit control stations have hinged covers. The hinge can easily be changed in the field from one side to the other.



ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

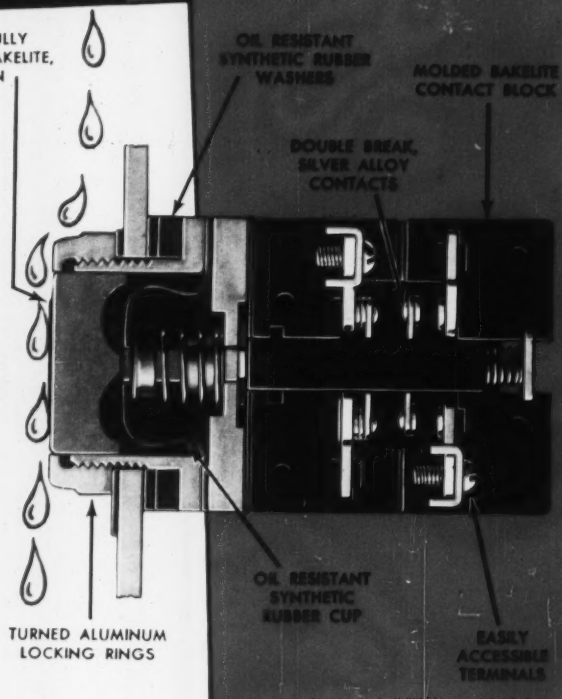
12-57-MR

for machine tool application . . .

BULLETIN 800T oiltight control units

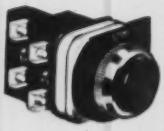
These rugged, reliable units were designed as pilot controls for a-c and d-c magnetic motor control. The oil resistant synthetic rubber cup and washers keep cutting fluids and oil away from the contacts, and thus prevent trouble. Push button units can be furnished with one, two, or four contact blocks—each equivalent to a separate single pole, double throw, switch unit.

For attractive appearance plus long life with reliable operation, select Allen-Bradley control units.

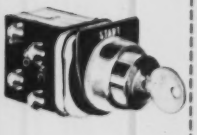

LARGE, FULLY GUARDED, BAKELITE, BUTTON
OIL RESISTANT SYNTHETIC RUBBER WASHERS
MOLDED BAKELITE CONTACT BLOCK
DOUBLE BREAK, SILVER ALLOY CONTACTS
OIL RESISTANT SYNTHETIC RUBBER CUP
EASILY ACCESSIBLE TERMINALS
TURNED ALUMINUM LOCKING RINGS

PUSH BUTTONS

Flush Head Start" Button

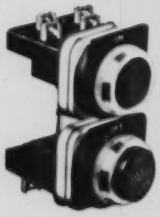

Extended Head "Stop" Button

Mushroom Head for Easy Operation


Push Button with Cylinder Lock

Push Button with "Selector" Sleeve

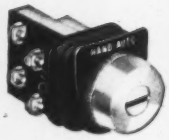
Wing Lever Push Button

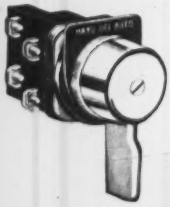

Maintained Contact Push Buttons

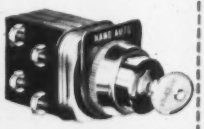
SELECTOR SWITCHES

Three-Position Selector Switch

Two-Position Coin Slot Selector Switch



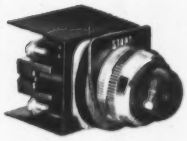

Wing Lever Selector Switch

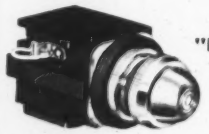

Selector Switch with Cylinder Lock

PILOT LIGHTS

Transformer Type Pilot Light

Full Voltage Pilot Light



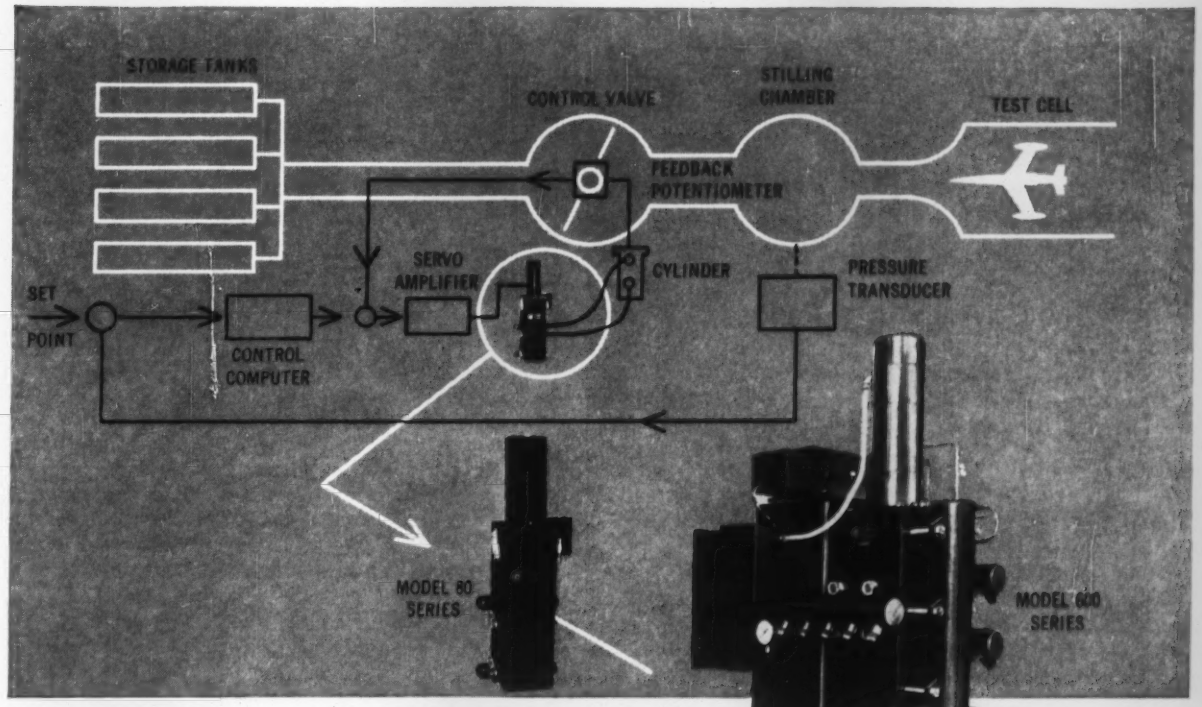

"Press-to-Test" Pilot Light

A-B QUALITY

ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

Allen-Bradley Co.
1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

12-57-MR



ELECTRO-HYDRAULIC PILOT VALVES

CAPACITIES TO 600 GPM

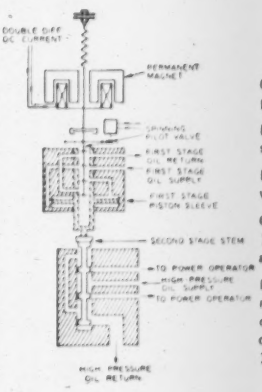
Frequency Response - to 10 cps - Accuracy - better than 0.1% - Hysteresis - less than 0.05%

Hagan PowrAmp Electro-Hydraulic Pilot Valves are dc actuated, permanent magnet motor driven, two stage servo valves used for the transfer and control of high pressure hydraulic fluid to power cylinders or motors driving dampers, valves, test models etc. As seen in the diagram at right, dc current inputs drive the first stage spinning pilot valve. This first stage hydraulic output drives the first stage piston-sleeve and the second stage high pressure stem.

Operating with supply pressures of up to 2000 psig and available in 18, 54, 80, 185, 369 and 600 gpm capacities at 2000 psi pressure drop, the Hagan Electro-Hydraulic Pilot Valve can control up to 300 usable hydraulic horsepower. Its permanent magnet motor and spinning pilot valve design provide virtually a frictionless and hysteresis-free valve as compared with the conventional iron core solenoid type of valve. The complete isolation of first and second stage valves allows the second stage to be applied in pneumatic service if desired.

This high power servo valve is a part of the Hagan "PowrAmp" line which also includes transducers for most key variables and electronic control computers. Available as separate components or as units of engineered systems, the complete line is described in Bulletin MSP-133, which will be sent on request.

For additional information on the Hagan Electro-Hydraulic Pilot Valve, write for Specification Sheet GH-300.



SPECIFICATIONS

Capacities—Up to 600 gpm at 2000 psi drop

Hysteresis—Less than .05% full valve stroke

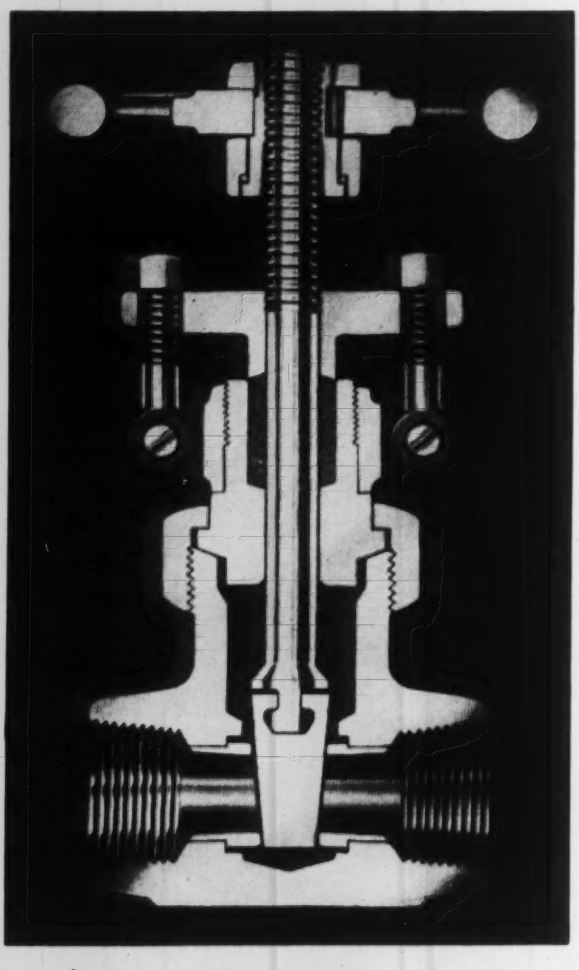
Repeatability—Better than 0.1% full valve stroke

Closed Loop Frequency Response—1½ to 10 cps depending on model and load

Input—Double differential dc currents of ±50 ma. Resistance of each coil 500Ω. Maximum current, each coil, 100ma. Maximum voltage, 100 vdc.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED
OFFICES IN: MONTREAL, TORONTO, VANCOUVER, EDMONTON



The Feeling is **MUTUAL**

CHAPMAN LIST 960
Forged Steel Gate Valves

You want small steel valves that give the best performance and cost the least for maintenance. Chapman thinks the same way and does everything possible to give you what you want.

On Chapman List 960 Forged Steel Gate Valves the wedge faces are *super* hard. They're hardened to 800 Brinell by Chapman's exclusive Malcomizing process. They can't seize. They can't gall. They're built for rugged service.

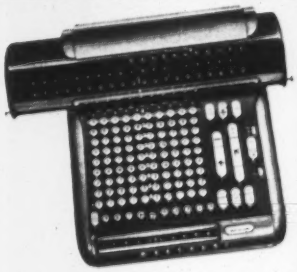
Even the long lasting seat rings are hardened stainless steel and are very easy to replace when necessary. Also, you have no full-pressure repacking difficulties with Chapman List 960 valves.

Today, there are more Chapman List 960 valves on more jobs than any other small forged steel gate valve. Valve men and Chapman see eye to eye on performance and costs. List 960's come in sizes from ¼″ to 2″. They stand up perfectly under conditions from 380 psi at 1000°F. to 2000 psi at 100°F. Of course, for higher pressures you use Chapman List 990 valves.

With the 960's you can order Bonnet joint either gasketed or ground metal-to-metal. You can have rising stem with yoke or rising stem with inside screw. You find them all in our Catalog 10. Write today for a copy.

The CHAPMAN
Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

Waldes Truarc Rings speed assembly, facilitate maintenance, improve performance of new automatic calculator

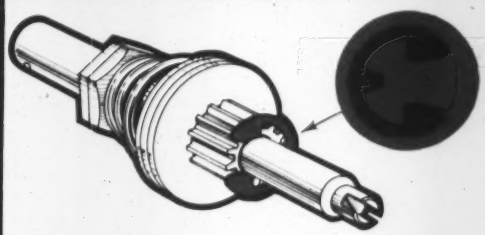


THE NEW MARCHANT DECI • MAGIC

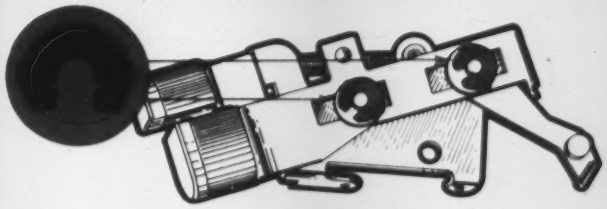
automatic-decimals calculator made by Marchant Calculators, Inc., Oakland, California.

CRESCENT RING SPEEDS ASSEMBLY, DISASSEMBLY

Main clutch utilizes radially-installed series 5103 crescent ring for rapid assembly and disassembly. Ring's low protruding shoulder provides necessary clearance between ring and the two studs. The main clutch operates each time a Deci-Magic control key is depressed.



E-RING SECURES PARTS AGAINST SPRING THRUST. Slip clutch assembly uses Truarc series 5133 E-ring to hold parts on shaft. Functioning of the assembly is dependent upon the ring's ability to withstand thrust exerted by the heavy barrel spring.



LOCKING PRONG RINGS PERMIT SIMPLE DESIGN. Shift slide assembly uses two Truarc series 5139 bowed locking prong rings to lock the parts together in a sliding fit. Precise amount of spring tension prevents objectionable wobble and noise, permits the key to slide smoothly in operation. Easy radial assembly and disassembly of rings facilitates field maintenance and repair. Alternative construction would have required cut washer, spring washer and hairpin-type spring clip on each stud.

Whatever you make, there's a Waldes Truarc Ring designed to save you material, machining and labor costs, and to improve the functioning of your product.

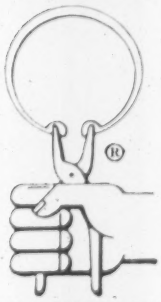
In Truarc, you get

Complete Selection: 36 functionally different types. As many as 97 standard sizes within a ring type. 5 metal specifications and 14 different finishes. All types available quickly from leading OEM distributors in 90 stocking points throughout the U. S. and Canada.

Controlled Quality from engineering and raw materials through to the finished product. Every step in manufacture watched and checked in Waldes' own modern plant.

Field Engineering Service: More than 30 engineering-minded factory representatives and 700 field men are at your call.

Design and Engineering Service not only helps you select the proper type of ring for your purpose, but also helps you use it most efficiently. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.



WALDES

TRUARC®

RETAINING RINGS

WALDES KOHINOOR, INC.

47-16 AUSTEL PLACE, L. I. C. 1, N. Y.

New Catalog

Waldes Kohinoor, Inc., 47-16 Austel Place, L.I.C. 1, N.Y.

Please send new, descriptive catalog showing all types of Truarc rings and representative case history applications. *(Please print)*

Name _____

Title _____

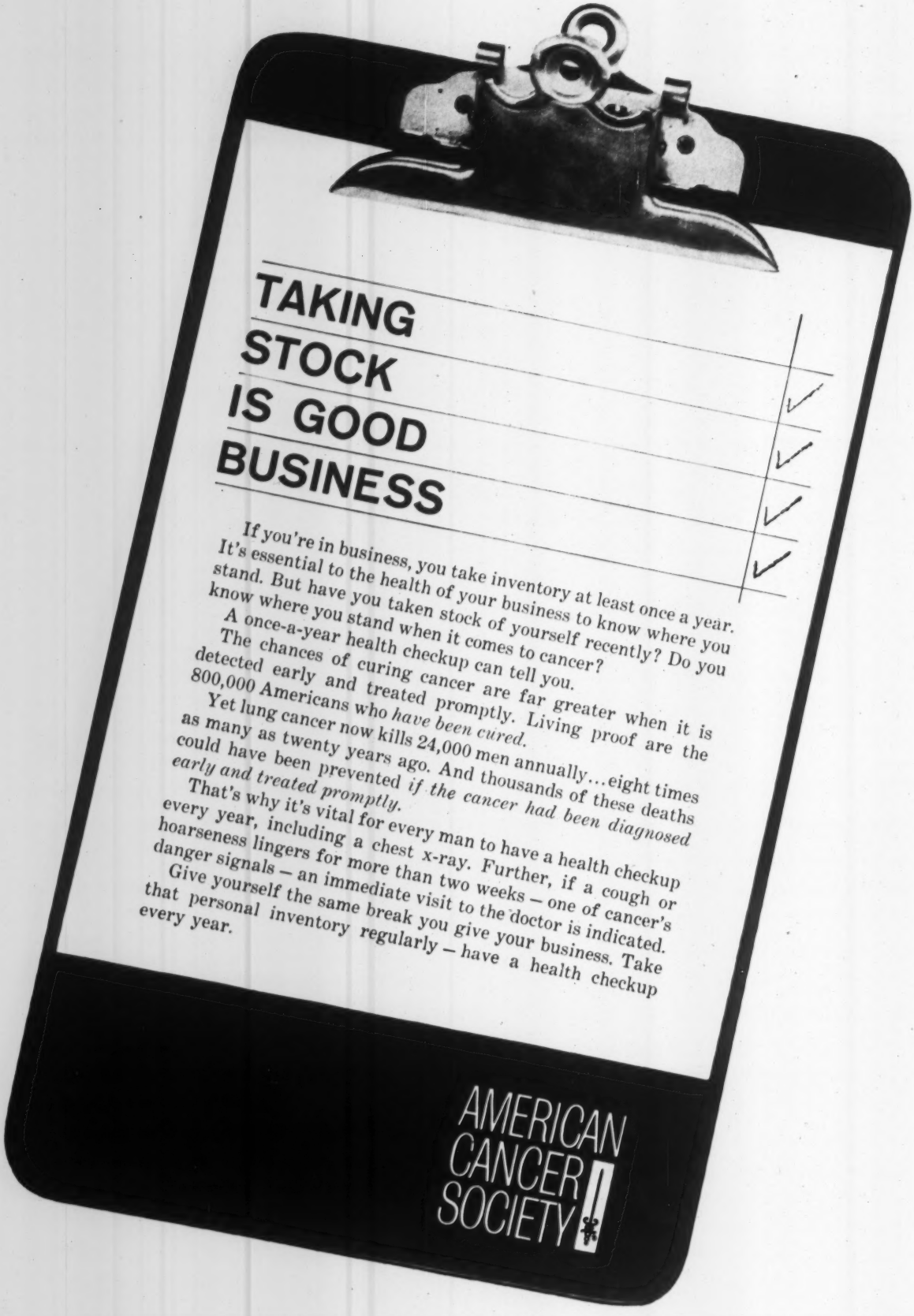
Company _____

Business Address _____

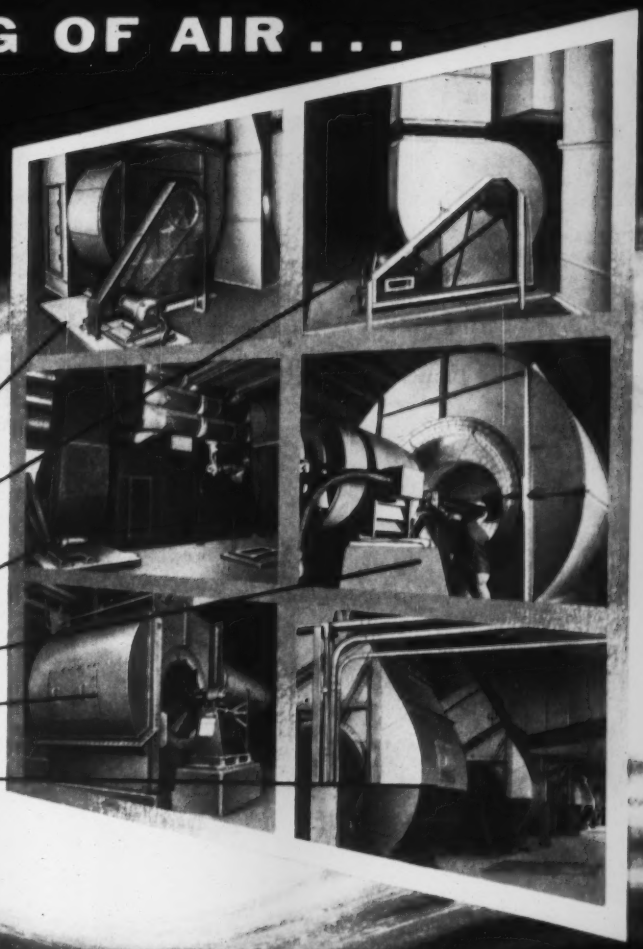
City _____ *Zone* _____ *State* _____

ME 119

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.


TAKING
STOCK
IS GOOD
BUSINESS
If you're in business, you take inventory at least once a year. It's essential to the health of your business to know where you stand. But have you taken stock of yourself recently? Do you know where you stand when it comes to cancer?
A once-a-year health checkup can tell you.
The chances of curing cancer are far greater when it is detected early and treated promptly. Living proof are the 800,000 Americans who *have been cured.*
Yet lung cancer now kills 24,000 men annually...eight times as many as twenty years ago. And thousands of these deaths could have been prevented *if the cancer had been diagnosed early and treated promptly.*
That's why it's vital for every man to have a health checkup every year, including a chest x-ray. Further, if a cough or hoarseness lingers for more than two weeks – one of cancer's danger signals – an immediate visit to the doctor is indicated.
Give yourself the same break you give your business. Take that personal inventory regularly – have a health checkup every year.
AMERICAN CANCER SOCIETY

NOW! A NEW STANDARD FOR THE HANDLING OF AIR . . .



FOR

1. Building Ventilation
2. General Supply and Exhaust
3. Conventional and High Pressure Air Conditioning
4. Vehicular Tunnel Ventilation
5. Industrial Processing
6. Combustion Air Supply

Series 8000

NEW AIRFOIL CENTRIFUGAL FANS!

. . . the new standard in a complete line

FULL RANGE APPLICATION

GENERAL PURPOSE

Classes I and II

Up to 6¾" Total Pressure

HEAVY DUTY

Classes III and IV

Up to 16¾" Total Pressure

Up to 700,000 CFM

Westinghouse Airfoil Blading has proved its effectiveness in six years of operation by two hundred customers in Mechanical Draft, Industrial Process, and High Pressure Air Conditioning.

Westinghouse now obsoletes conventional flat blading and brings you the efficiency and quietness of Airfoil Blading for ALL PURPOSE applications in a complete standard line of Centrifugal Fans, covering every requirement up to 700,000 CFM . . . Up to 16¾" total pressure.

J-80640

WESTINGHOUSE AIRFOIL CENTRIFUGAL FANS NOW GIVE YOU . .

- ★ **LOWEST OPERATING COSTS . . .** High Efficiency — Low Horsepower!
- ★ **QUIET OPERATION . . .** Airfoil Blading — Streamlined Air Flow!
- ★ **CAPACITY PROTECTION . . .** Steep Pressure Curve — Minimum Capacity Variation!
- ★ **NON-OVERLOADING POWER FEATURE!** Full Load at Motor Rating—No Overload!
- ★ **AMCA (NAFM) STANDARD SIZES!**

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE . . . IF IT'S Westinghouse

. . . Fluid Power news

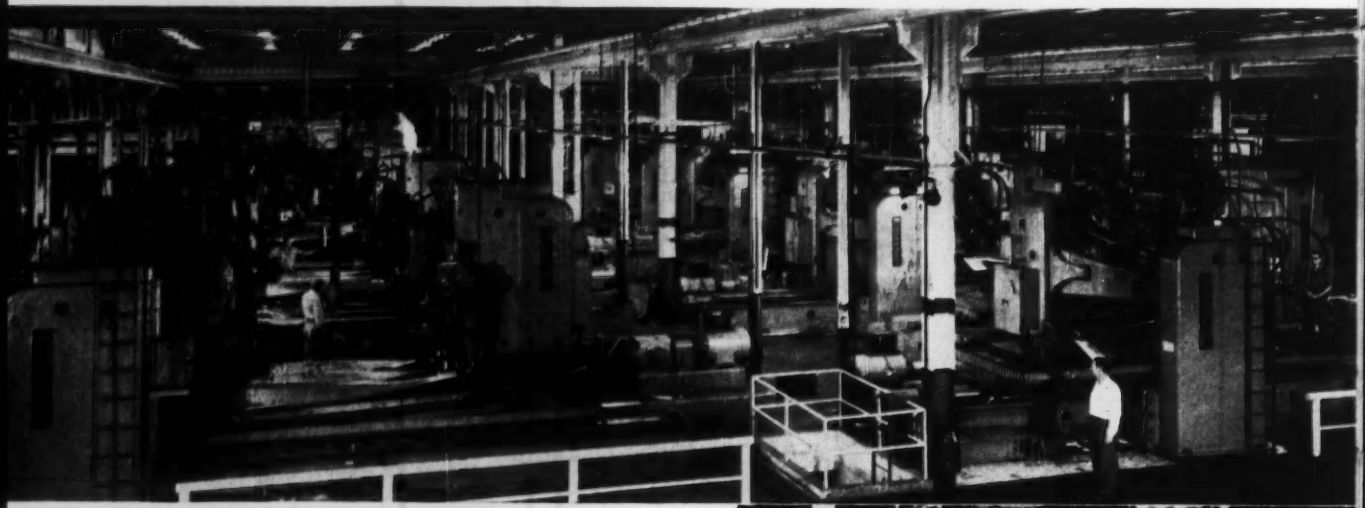
REPORT NO. 11,600 AID TO MACHINE DESIGN PROGRESS

From Oilgear Application-Engineering Files

HOW OILGEAR ENGINEERING TEAMWORK AIDS MACHINE DESIGN PROGRESS

CUSTOMER: Rockford Machine Tool Company

DATA: Application of Fluid Power system to planers that mass-duplicate the airfoil on new, solid, forged steel propeller blades. Six years has been spent on the development and manufacturing methods to produce this new blade. Planers to be equipped with tracer attachments to machine blades from master templates. Desired profile is completely machined to proper thickness . . . maintaining accurate airfoil on both sides of blade. Requirements: extreme accuracy; flexibility of control; elimination of shock, vibration and gear marks on work; independent, fast cutting and return speeds to keep costs to a minimum.



SOLUTION: Shown above are 20 Oilgear-equipped, Rockford Hy-Draulic planers machining aircraft propeller blades. Closeup (right) shows how Rockford's hydraulically operated "Kopy-Kats" can mass-duplicate four of these new-type, steel blades simultaneously from master templates. Rockford Machine Tool says of this set up, "The inherent advantages of hydraulic drive and control make this gigantic installation an extremely powerful production unit. Hydraulic drive is a natural for reciprocating machine tools. It's being proven daily in the world's finest machine shops." This is but *one* example of the ever increasing application of Oilgear-equipped machine tools. Rockford, and other designers and builders of tools for industry, have discovered that Oilgear *Application-Engineering* means cooperation and teamwork in supplying new production requirements . . . that Oilgear is more than just an "off-the-shelf" source of supply . . . that Oilgear is a Fluid Power design and engineering service based on over 35 years of pioneering and knowledge in precision, "Any-Speed" control, and efficient linear and rotary power systems. Because of this cooperative teamwork in solving problems—coupled with progressively engineered, trouble-free, dependable, Fluid Power control and drive systems—manufacturers have come to trust and depend upon Oilgear . . . the name that protects and enhances "OEM's" reputation, and assures satisfied users.

For practical solutions to YOUR *linear or rotary drive and control problems, call the factory-trained Oilgear application-engineer in your vicinity. Or write, stating your specific requirements, directly to . . .*

Rockford Machine Tool Company has used thousands of Oilgear Fluid Power Systems on planers and slotters since 1928, because of: 1: No costly high inertia, reversible, electric motors; complicated control systems, and reduced power consumption and vibration. 2: No racks, screws, gear trains. 3: Infinite speeds from 10 to 300 fpm, with 3 cutting force ranges-independent maximum return speed. 4: Shock-free, instant reversals for efficient short or long stroke cutting. 5: New, complete flexibility in operational control.

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

1570 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

TECHNIQUES and DEVELOPMENTS
in oscillographic recording

FROM
SANBORN

CIRCUIT DESIGN AND TYPICAL USES OF THE "150" CARRIER PREAMPLIFIER

One of the most frequently used plug-in front ends for Sanborn 150 Series oscillographic recording systems is the Model 150-1100 Carrier Preamplifier, since with it a "150" system can record such variables as force, temperature, strain, pressure, displacement, velocity, flow, acceleration — or any variable which can be expressed as a suitable input signal by a transducer. The "1100 Carrier" will operate with a variety of different transducers and bridge circuits, which will be mentioned later on.

In the block diagram (Fig. 1), a push-pull oscillator provides an excitation voltage of about 5 v. to the transducer at a standard frequency of 2,400 cycles or optional frequencies of 600 and 1,200 cycles, using plug-in components. This excitation voltage also feeds the Balancing, Calibration and Zero Suppression circuits. (The Balancing controls allow correction of resistive and reactive signal leakage from the transducer, so that at zero load the net signal to the Preamplifier is zero. The Zero Suppression feature permits bucking out a large static load so that a small part of the load can be expanded over the full recording chart. The Gage Factor control allows the zero suppression range to be made equivalent to some convenient transducer load, or the full load rating of the transducer, and also causes the calibration signal to represent 2% of that load.) Transducer output is fed to the transformer through the Gage Factor potentiometer, across which the Balancing-Calibration-Zero Suppression circuits develop a voltage effectively in series with the transducer output. The mixer receives a suppressed carrier AM signal and re-inserts a carrier component, to make its output a conventional AM signal whose modulation represents the transducer load. The modulation signal (whose amplitude and polarity represent magnitude and direction of transducer output) is recovered by the demodulator and fed to the output amplifier, which in turn excites the Driver Amplifier and recording galvanometer of a "150" system.

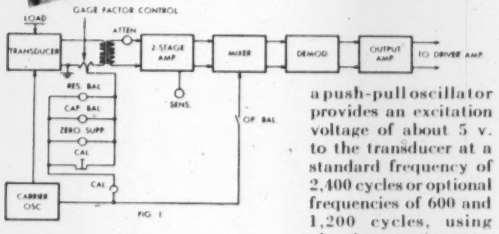


FIG. 1

Transducers which may be used with the Carrier Preamplifier include strain gage half-bridges or full-bridges, commercial resistance or reactance bridges, differential transformers and resistance thermometer bridges. The transducer chosen should provide at least 18.0 microvolts per volt of excitation at the minimum load to be recorded, for a one cm. deflection; impedance should be 100 to 1000 ohms. With strain gages, normal operation provides sensitivities of 50, 20 or 10 micro-inches per inch for each cm. on the recording, depending on the number of active gages. With resistance thermometers, if 1°C. or 2°F. per cm. stylus deflection is sufficient sensitivity, the user can construct his own resistance thermometer by including a 3 ohm coil of copper wire in one arm of an equal arm 100 ohm bridge.

Helpful information about the use of transducers with the 150-1100 Preamplifier is contained in the following Sanborn RIGHT ANGLE articles (reprints on request): Coupling Differential Transformers, Aug. and Nov. 1956; Filter Networks for use with Force Dynamometers, Nov. 1956; Calibration with 1-, 2- or 4-arm Strain Gage Bridges, Aug. 1955; Theoretical and Actual Applications of Bridge Circuits, May and Aug. 1954.

Wing flutter recording to infrared research . . . with the versatile "1100 Carrier"

Today, Carrier Preamp-equipped Sanborn "150" systems are being used for frequency response tests of process control system components; to record shaft deflections of fluid mixing equipment; in infrared research . . . vehicular traffic studies . . . submarine hull vibration measurements. Applications are limited only by the transducers available.

These are applications of only one "150" front-end; eleven more interchangeable, plug-in Preamplifiers increase the scope of Sanborn oscillographic recording systems to meet an almost infinite variety of research, production and field testing requirements. All Sanborn "150" direct writing systems record inkless traces in true rectangular coordinates; all provide 1% linearity; Basic Assemblies — equipped with your choice of Preamps — are available from one- to eight-channels, packaged in vertical cabinets, portable cases, or specially modified housings.

Technical data and help with your oscillographic recording problem are always available from Sanborn.

SANBORN COMPANY
INDUSTRIAL DIVISION
175 Wyman St., Waltham 54, Mass.

Nine Years of Operating Experience

SUPER-PURE

with the FW Dual Circulation Boiler

Low carryover of silica and solids, at design pressures up to 2200 psi, with low-purity feedwater and make-up as high as 100%, proves soundness of dual circulation design

EXPERIENCE with the FW dual circulation steam generator — now in the tenth year of successful operation — clearly demonstrates its effectiveness in producing high purity steam from waters which had previously been considered unsatisfactory for high-pressure boiler make-up. The following advantages have now been fully realized in installations with design pressures up to 2200 psi, and make-up as high as 100%.

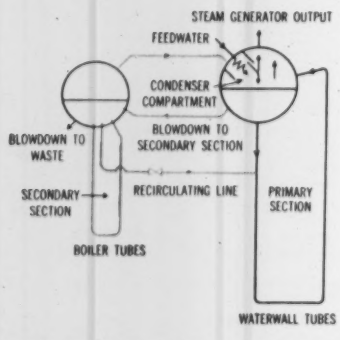
Sharply reduced carryover of silica and solids, preventing costly fouling of turbine blades.

Low concentration in high-duty furnace section, resulting in minimum tube damage and reduced boiler maintenance.

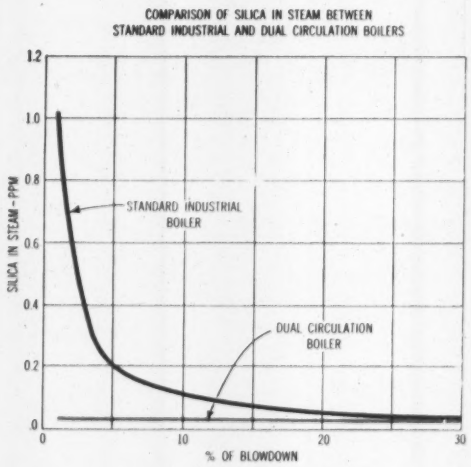
Reduced blowdown with lower heat loss and smaller heat recovery equipment.

Reduced feedwater purity requirements, permitting less expensive water treatment even with high make-up.

The dual circulation boiler utilizes *two* separate heat absorbing sections — a radiant *primary* section (where most of the steam is generated), and a low-heat-absorption *secondary* section (convection portion of boiler). Blowdown from the primary, usually at a high rate, provides feed for the secondary section. This reduces concentration in the primary section to a much lower value than in the secondary section. Steam generated in the secondary section is returned to the primary drum where it is scrubbed by feedwater and condensed in whole or in part before mixing with the primary steam. Even with high concentrations in the secondary, low steam release rates prevent excessive moisture carryover from this section. The effectiveness of this design in reducing carryover of silica to the turbine is well illustrated by the comparative test data plotted below for the conditions indicated. For further details on FW Dual Circulation Steam Generators, send for a copy of Bulletin B-50-11. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*



Simplified flow diagram showing principle of Dual Circulation. Secondary section and blowdown to secondary section are shown in color.



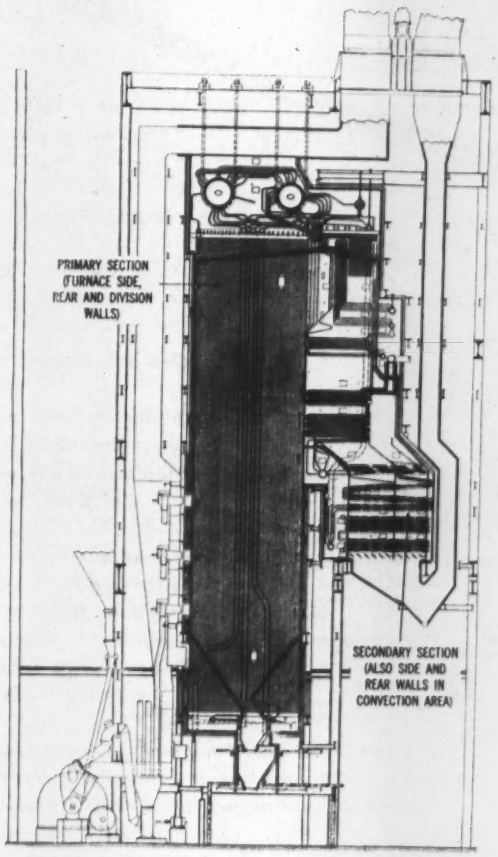
Drum Operating Pressure — Approx. 1500 psi.
Total Soluble Solids in Feedwater — 150 ppm
Silica (SiO_2) in Feedwater — 1 ppm
Evaporation in Secondary Sec. — 33% of total boiler output

FOSTER

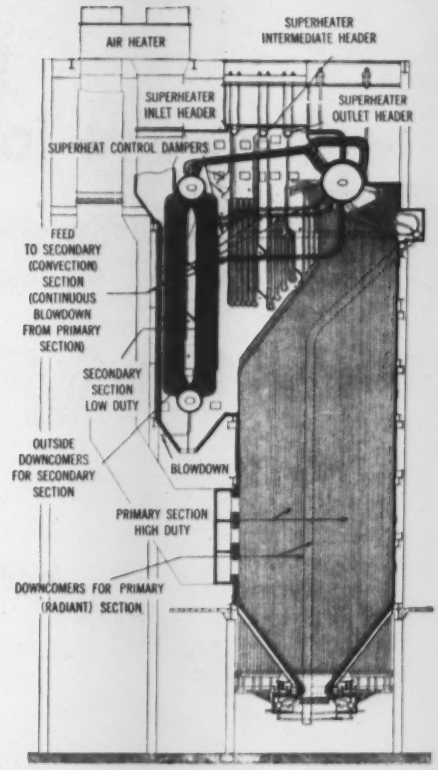
NEW YORK • LONDON

in Generating

STEAM

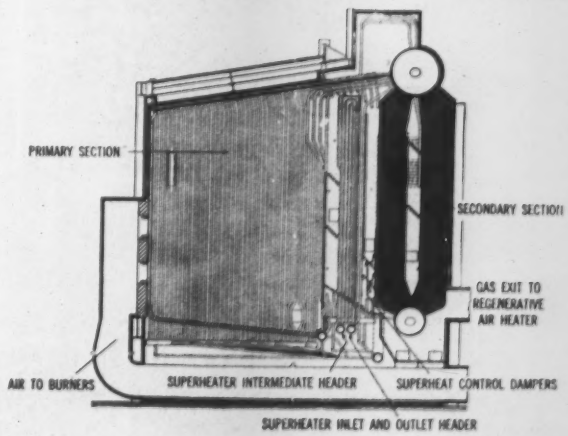


▲ Cross section of Dual Circulation reheat steam generator designed for a maximum continuous output of 1,450,000 lb/hr with a design pressure of 2075 psig, normally operating with low make-up. Steam temperature of 1000F is maintained over a load range from 500,000 lb/hr to maximum rating. The primary section consists of waterwall surface exposed to radiation from the flame and gases while the secondary consists of extended surface heated by convection.



▲ Cross section of a three-drum Dual Circulation Steam Generator designed for 300,000 lb/hr, 1500 psi, 900F, with 100% make-up. Steam-water mixture leaving wall tubes passes through washing and separating compartments in the primary drum. Water from the high-duty section is continuously blown down to the low-heat-absorption secondary section, shown in color. Steam from the secondary is returned to the primary and condensed by incoming feedwater.

Cross section of a two-drum Dual Circulation Steam Generator designed for 300,000 lb/hr, 700 psi, 750F, with high make-up. Here the primary and secondary sections are segregated within the single upper drum. The waterwall tubes comprise the high-heat-absorption primary section and the boiler bank or convection section comprises the low-heat-absorption secondary section. ▼



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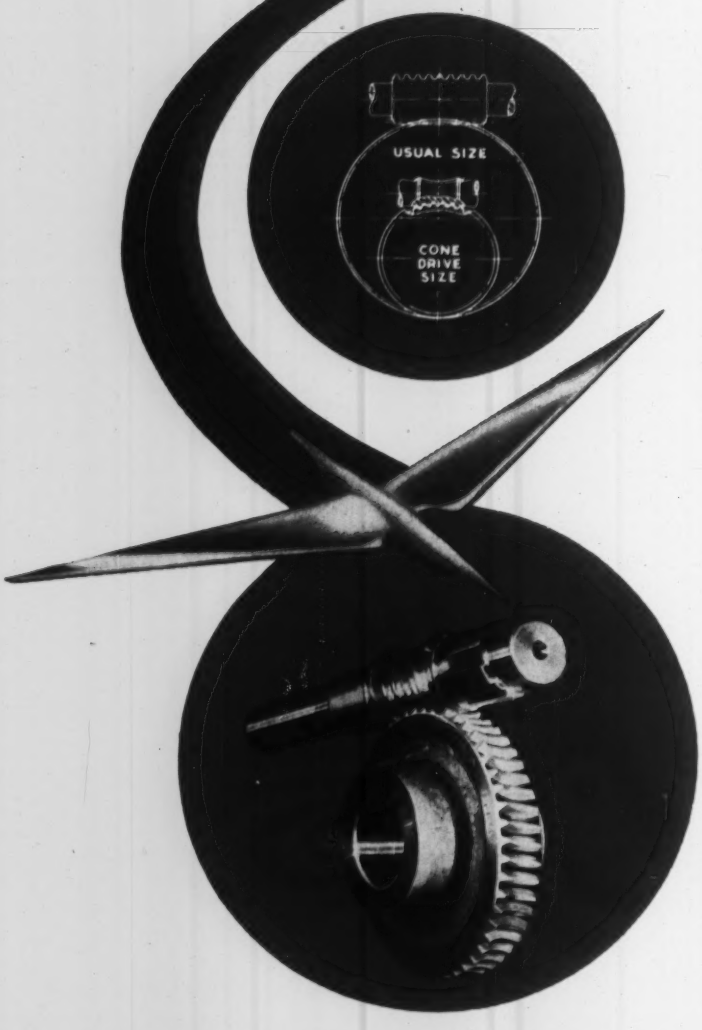

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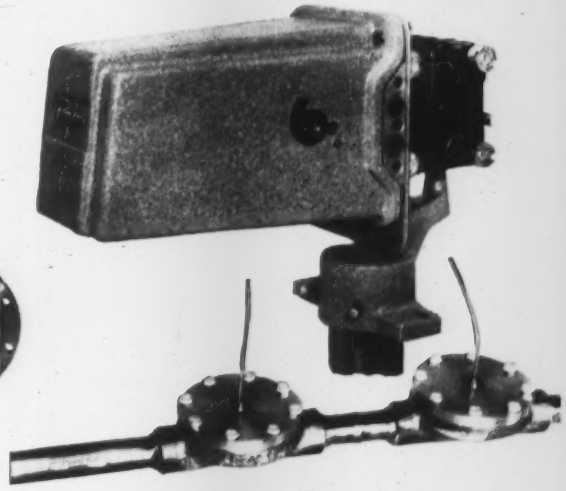
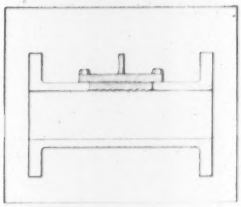
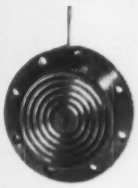
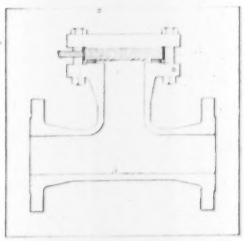




Type 95 flange (*right*), for use with chemical tee. For flow installations where diaphragm is flush with the inside of pipe, so that process fluid imparts a scouring action. Also for liquid level requiring flush installation. Maximum pressure 300 psi.





Wafer type sensing element (*above*), for use with standard 3" ASA flange, where diaphragm need not be flush mounted, e.g., corrosive flow or liquid level measurement. Standard diaphragm material, for both types, 316 Stainless Steel; alternates available. Maximum pressure 1500 psi.

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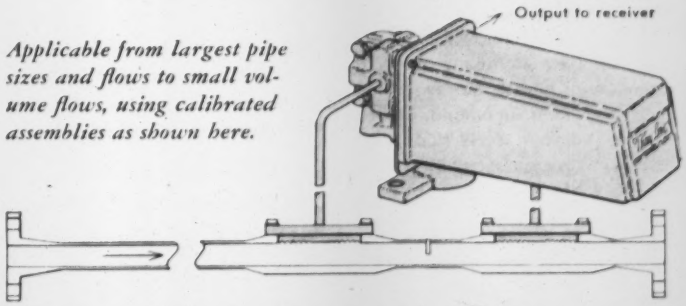

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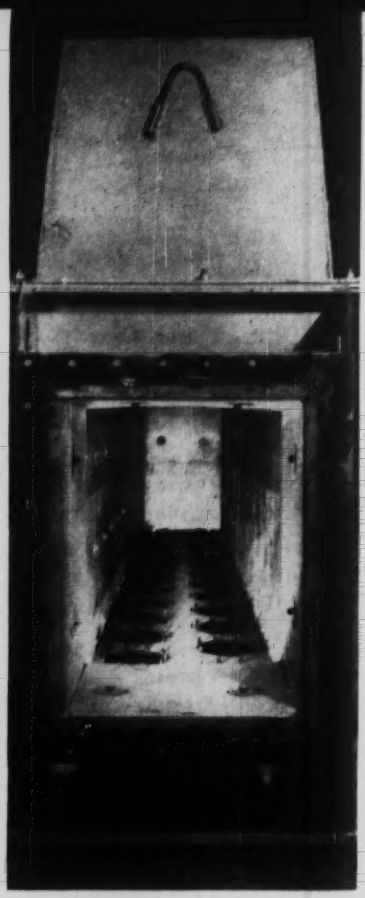

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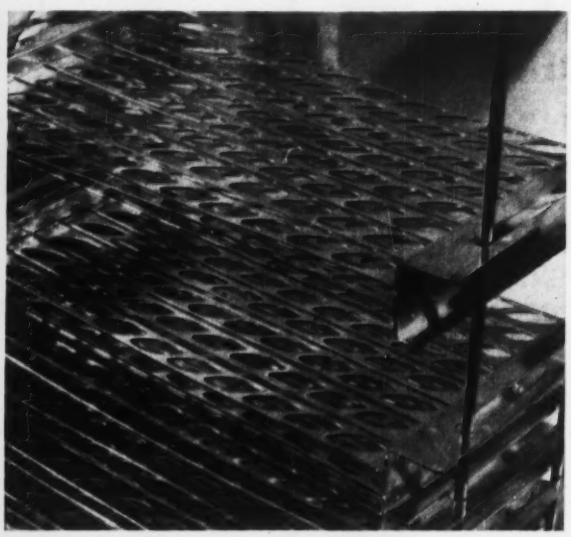

For Cleanliness. When you work near nuclear radiation areas, you wear a small badge containing X-ray film that records how much radiation you have received. The film, "photodosimetric film," is developed in a Sensitometric Processing Unit made by Bar-Ray Products, Inc., in Brooklyn. The unit, including the trays shown here, is made completely from 18-gage Type 316 Stainless Steel because it resists corrosion, is easy to clean, has a hard, dense surface that doesn't harbor dirt.

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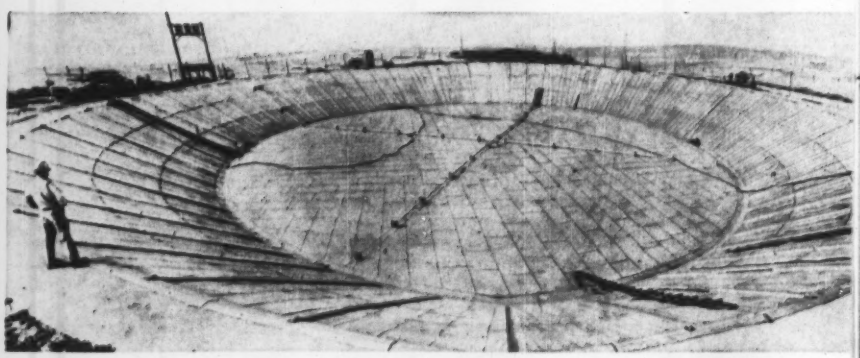

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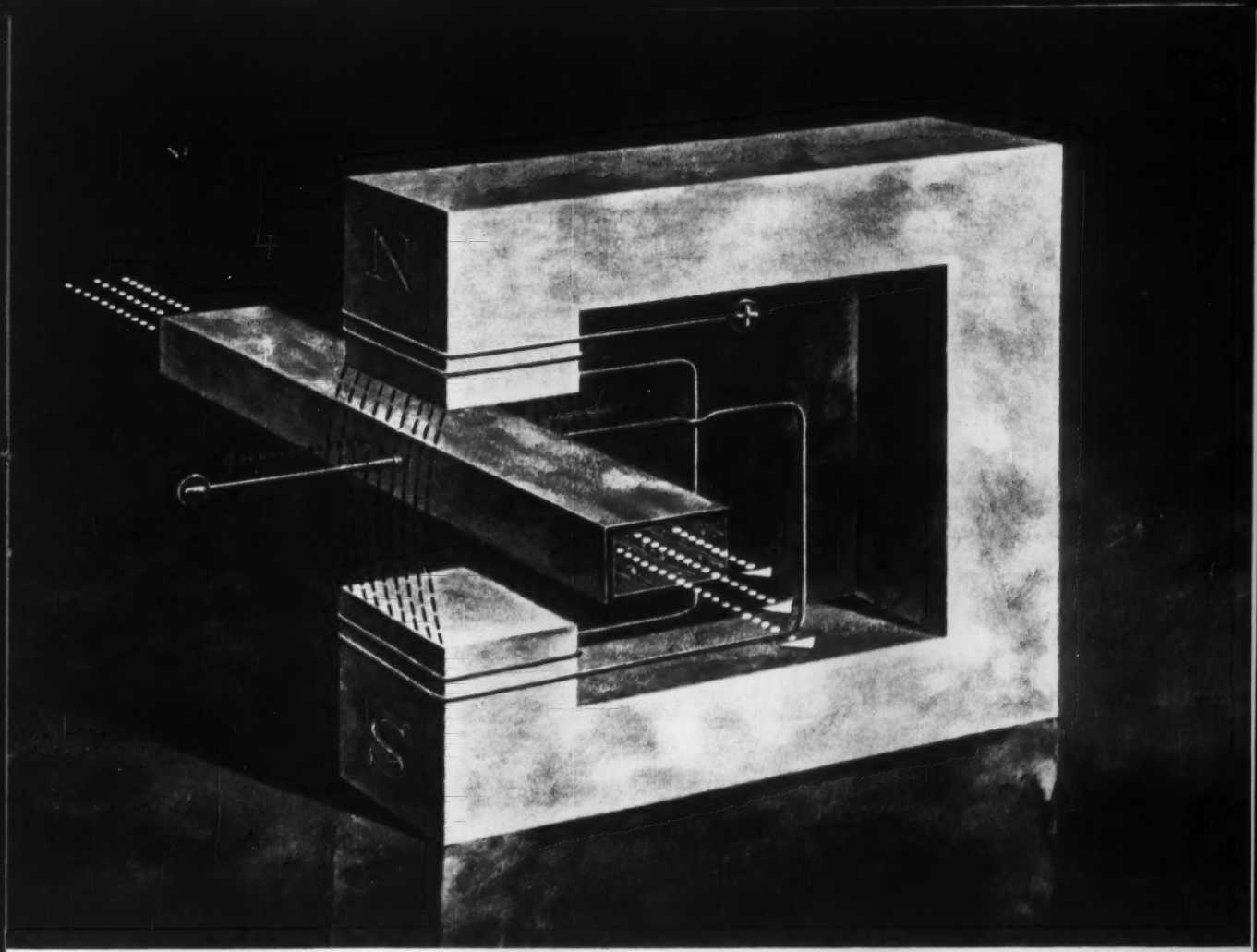

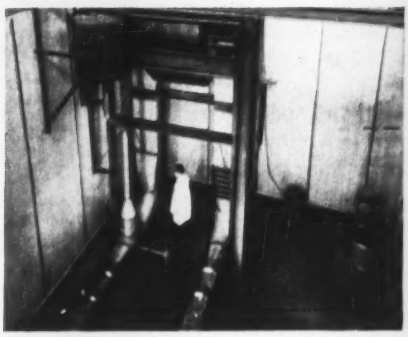

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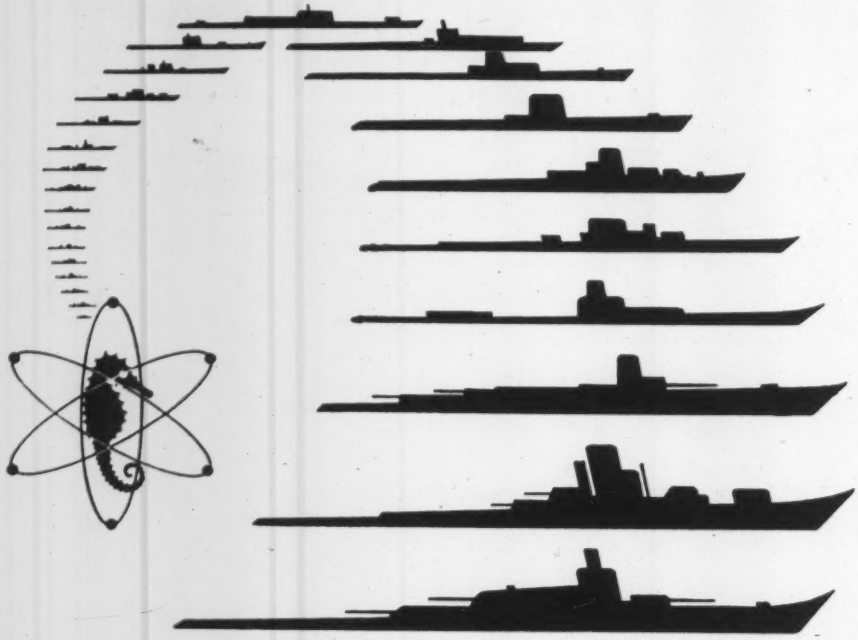

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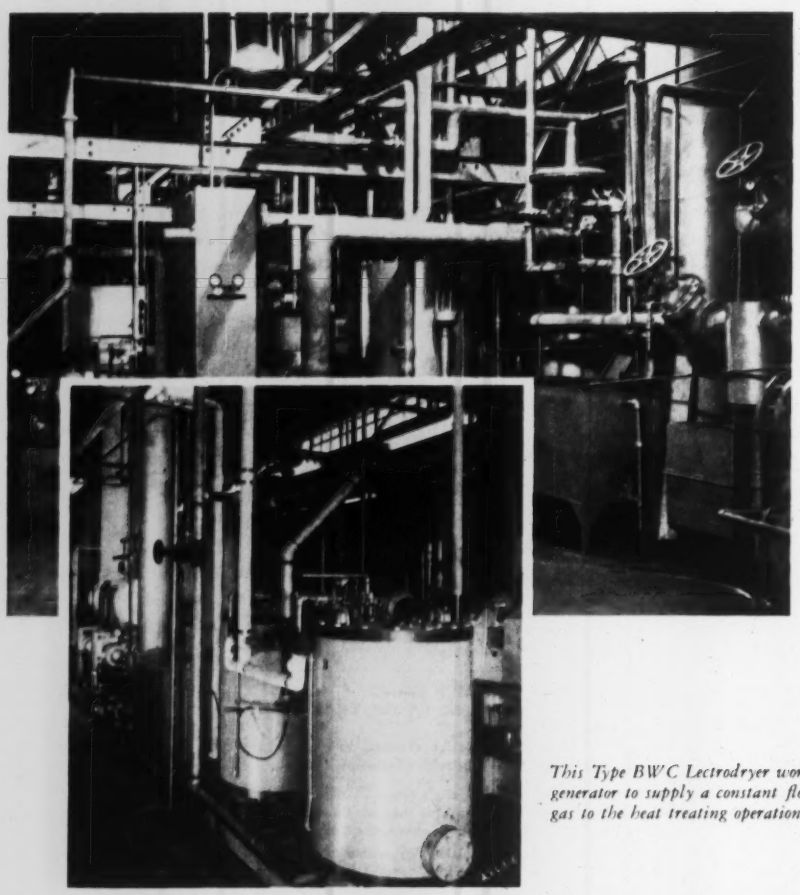

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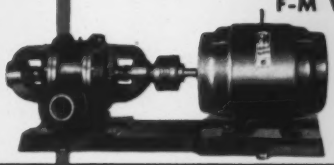
boiler feed condensate return hot and cold liquids chemicals refrigerants, etc.	up to 200 gpm. pressures to 900 ft.	 **F-M WESTCO PERIPHERAL PUMPS** High pressure at normal operating speeds. Handle widely varying heads with little change in capacity. Sizes 1¼" through 2½".
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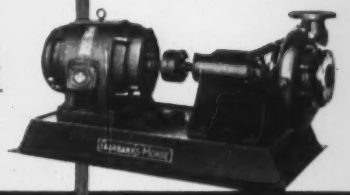
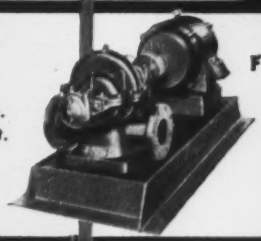
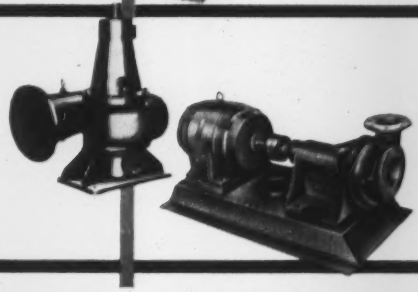
sewage slurries paper stock fruit shrimp vegetables, etc.	up to 30,000 gpm. pressures to 175 ft.	 **F-M NON-CLOG PUMPS** Unexcelled for clog-free handling of liquids with solids in suspension. Sizes 2" through 20". Vertical or horizontal. Bladeless or conventional.
water supply plant service booster circulating air conditioning refrigeration chemical liquids boiler feeds, etc.	up to 50,000 gpm. pressures to 700 ft.	 **F-M SPLIT-CASE CENTRIFUGAL PUMPS** High, sustained efficiency over wide range of conditions. Low-cost maintenance. Sizes 1½" through 36". Single stage or multistage.
hot and cold liquids chemicals circulating liquids nonviscous liquids cooling towers condenser circulation, etc.	up to 100,000 gpm. pressures to 250 ft.	 **F-M END-SUCTION PUMPS** A wide line of rugged, precision-built pumps. Sizes ¾" through 54". Horizontal or vertical centrifugal.

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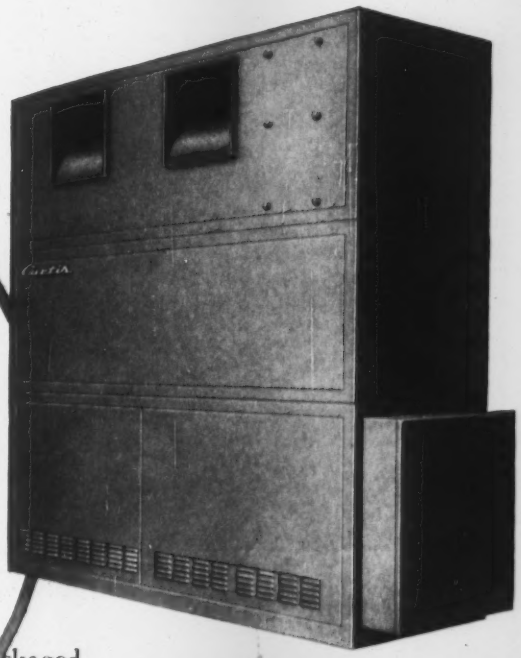
PACKAGED UNITS *Up to 50 Tons* OPENS NEW MARKETS FOR PACKAGED AIR CONDITIONING



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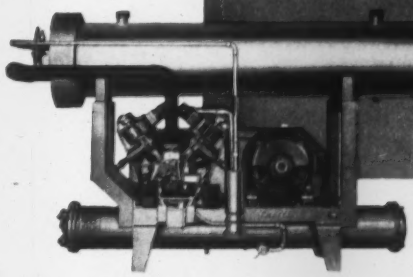

up to 100 tons—

With all controls in single panel box for easier access and greater protection! Four step capacity control—unloaded starting available. Particularly desirable where year 'round conditioning of multiple individual rooms is required.

REMEMBER, every Curtis unit is backed by a solid 103 years of experience and skill. Curtis offers a complete line of air conditioning equipment—nationally advertised to help you sell.

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New Curtis Packaged, Air Cooled, Air Conditioning Units, 3 thru 7½ tons. Residential and commercial applications.

Condensing Units up to 100 tons. F-12 or F-22.

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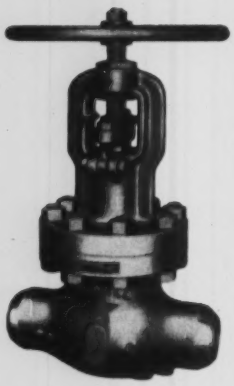

Fig. 6031S-WE—600-Pound Steel Globe Valve for Steam Service. Outside Screw Stem and Yoke.

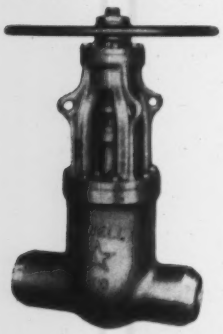

Fig. 19003—Powell Steel Pressure Seal Gate Valve for 900 Pounds W.S.P.

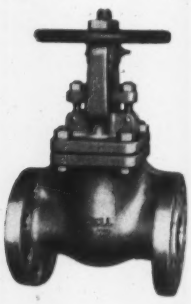

Fig. 2467—Small 300-Pound Stainless Steel O.S.& Y. Gate Valve. For handling boiler feed water treating solutions.

Fig. 1793—Iron Body Bronze Mounted O.S.& Y. Gate Valve for 125 Pounds W.S.P.

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Consult your Powell Valve Distributor for full facts about quality proved bronze, iron, steel, and corrosion-resistant valves. For every flow control problem—there is a Powell Valve to solve it . . . *better.*

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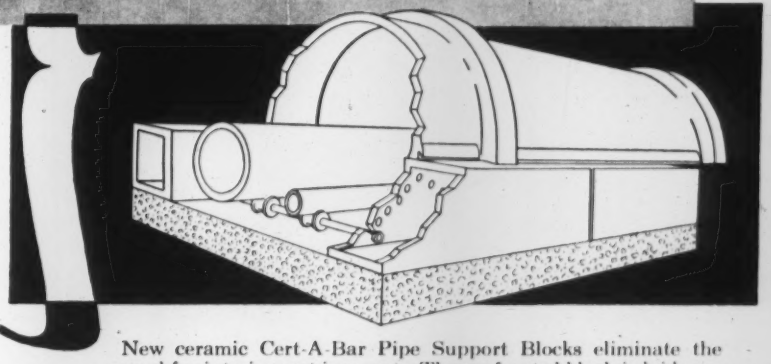
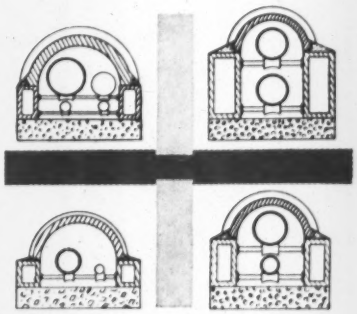
for underground piping!

STILLWATER CERT-A-BAR* TUNNEL CONDUIT SYSTEM



New ceramic Cert-A-Bar Pipe Support Blocks eliminate the need for interior cast iron rests. The perforated block is laid as a structural support member at regular intervals, and the bars are simply inserted and locked in place.

THE vital consideration in selecting an underground conduit system is *permanent* protection . . . not for one year or five, *but for the life of the piping.* You get the best possible protection for your underground metal service piping with a Stillwater Conduit System of vitrified clay. It's chemically inert—can't rust, rot, corrode, or decay . . . ever. And it is manufactured in accordance with ASTM specification C-13-54, assuring proper strength and quality. Any combination of service piping can be protected. Conduit is available in a wide range of sizes, with a complete line of fittings and accessories, including alignment guides, lateral guides, and anchors. Any contractor's crew can handle the installation easily, or if you prefer, Stillwater Licensed Installers will assume the responsibility. The Cert-A-Bar Tunnel System can be installed with any of three suggested new waterproofing specifications —one for average conditions, one for intermittent ground water conditions, and a third for high water table conditions. It's the lowest-cost conduit per year of service that you can specify or install!



THE CERT-A-BAR SYSTEM HAS ALL THESE IMPORTANT ADVANTAGES

- Inherent structural strength for permanent protection
- Complete flexibility for design
- Minimum initial and long-term costs
- Quickly installed
- Keeps pipe insulation dry
- No electrolytic corrosion of piping
- No maintenance required

A few of the hundreds of possible combinations of piping for the Cert-A-Bar Tunnel System are shown at left.

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illustrated, four-page circular with complete installation specifications.

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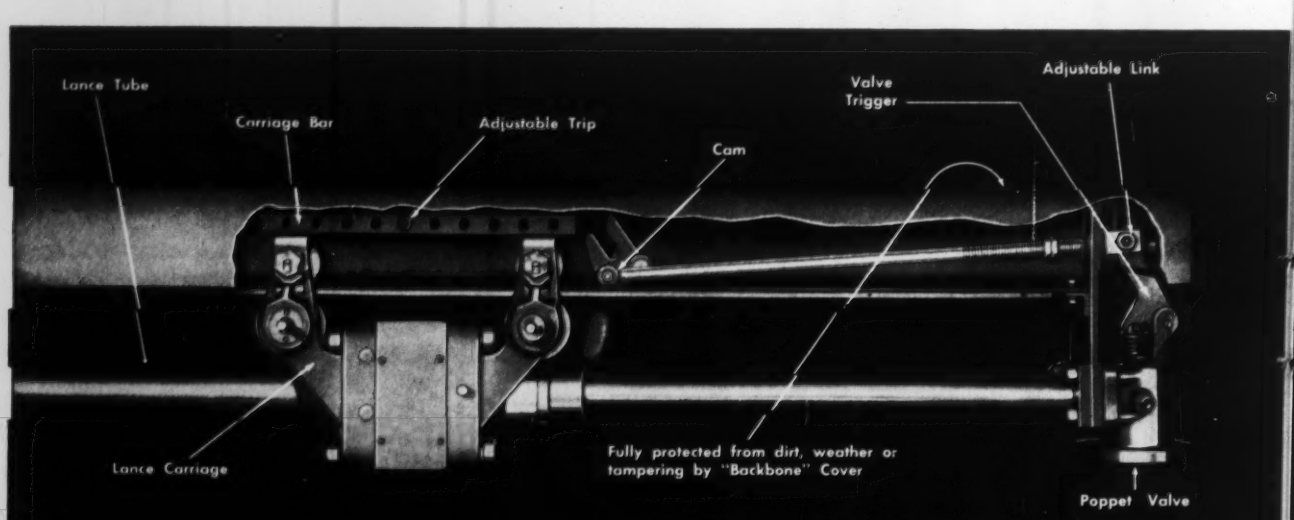

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OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

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(WITH ADJUSTABLE PRESSURE CONTROL)

additional important features of the

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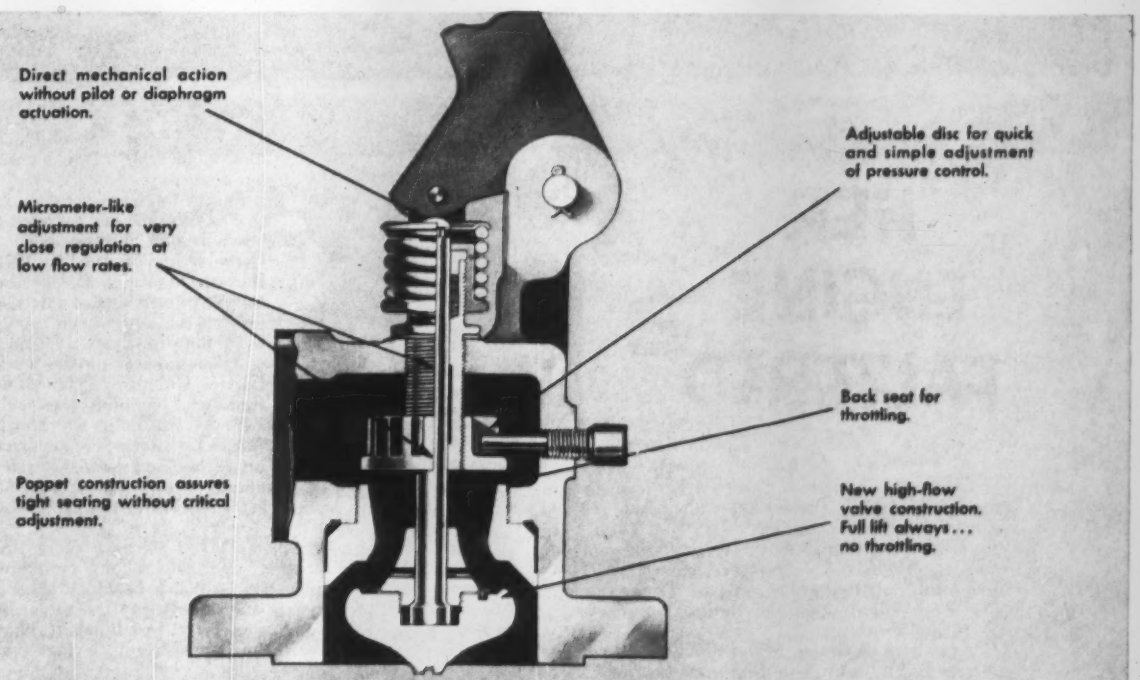
LONG RETRACTING BLOWER

This valve was adopted for the new Series 300 IK because long experience has proved it the most satisfactory of all designs for severe blower service. More than 300,000 of this basic design are in use on various Diamond Blowers and have established notable service records. A recent improvement is more streamlined flow contours that permit higher flow rates with less pressure drop.

The direct mechanical linkage for actuating the valve offers the advantages of greater reliability and safety . . . in addition to more accurate control. Numerous other important features of the Series 300 IK are listed at the bottom of the left hand page. These are the reasons why this blower is establishing a new standard of efficiency, economy and dependability in cleaning heating surfaces that require a long retracting blower.

Bulletin 2111AA tells much more about the Series 300 IK; ask your local Diamond office or write directly to Lancaster for a copy.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Micrometer-like adjustment for very close regulation at low flow rates.
Poppet construction assures tight seating without critical adjustment.
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New high-flow valve construction. Full lift always... no throttling.

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In the channel fog

HER ENGINE FALTERED

A few minutes out of Dover, fog wrapped the flimsy Bleriot monoplane like a shroud.

The pretty young woman in the smart flying costume (she'd designed it herself—"bloomers, blouse, and hood of mauve satin") glanced at her compass. It was the first time she'd ever used one. She thought of instructor Hamel's parting words:

"Be sure to keep on course, Miss Quimby, for if you get five miles out of the way, you'll be over the North Sea, and you know what that means."

She climbed to 6,000 feet. Freezing cold and still fog. She pointed her nose down. The comforting clatter of the Gnome engine changed to a coughing splutter. It was conking out! She leveled off, figuring how she'd ditch. To her relief, the engine suddenly took hold. Harriet re-checked her compass.

Some time later, breaking into clear sky, she saw a stretch of beach below. She put down at Hardelot; and on April 16, 1912, Harriet Quimby, first American woman to earn a pilot's license, became the first woman in the world to fly the English Channel.

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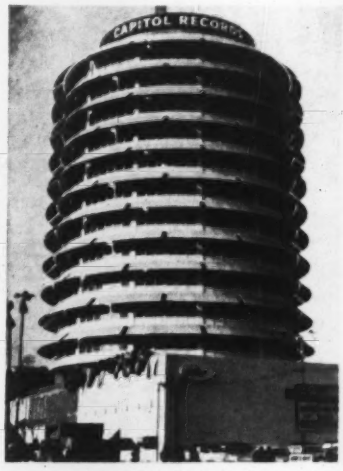

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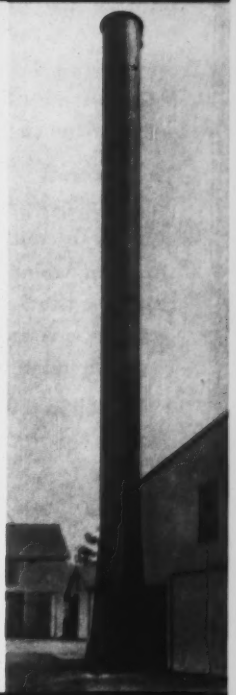

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NOTICE

REGARDING U. S. PATENT 2355966

U.S. Patent 2355966 covers the Z-Crete system of insulating underground hot pipes. Millions of feet of trouble-free, efficient, permanent Z-Crete have been installed throughout the world by licensed applicators under the patent.

The success of this patented system, however, spawned numerous imitators, and led to confusion among specifiers and users of underground insulation.

In order to protect engineers, contractors and owners, Zonolite Company found it necessary to go to the courts and test the validity of its patent on Z-Crete.

The United States Court of Claims' decision (April 3, 1957) ruled the patent valid and infringed. A favorable decision in a subsequent civil suit in the United States District Court in Maryland (July 18, 1957) reaffirmed the scope of the patent.

The successful adjudications of the Z-Crete patent allows Zonolite Company and its licensees to continue their intensive research program, which has already led to vastly improved results in underground hot pipe insulation, making today's Z-Crete the finest system available.

If you'd like the latest data on Z-Crete underground conduit systems, please send for brochure Z-1.

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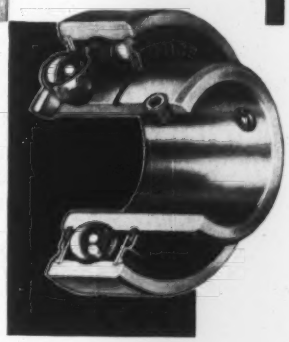

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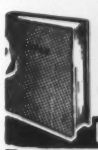

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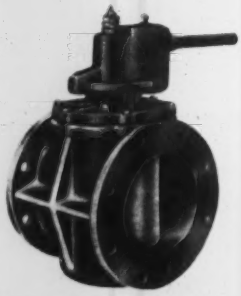

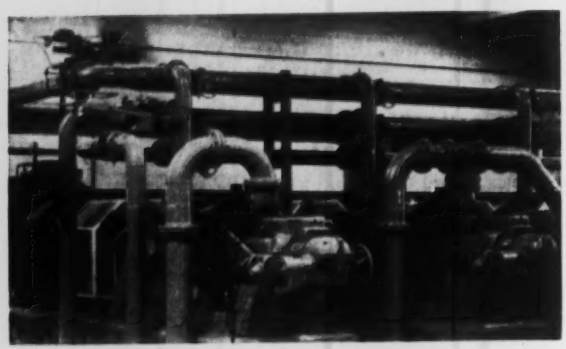

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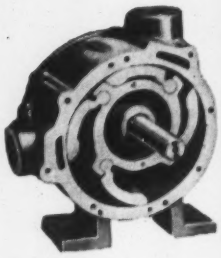

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2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for revised Engineering Manual describing complete line. Dept. Me-57.

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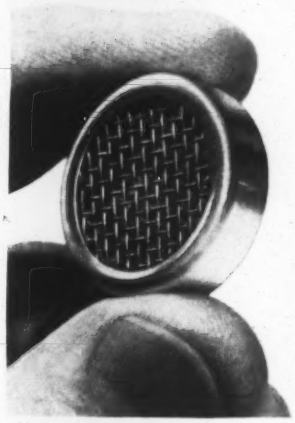

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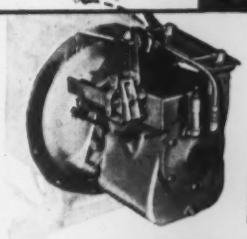
CONTROLS SPEED AND DIRECTION OF TRAVEL



- NO GEAR SHIFTING
- NO CLUTCH WORRY
- MORE WORK PER HOUR
- REDUCED MAINTENANCE

FUNK revers-O-matic DRIVES

Other Funk Products

Funk Standard Power Take-Off

Funk Gear Reduction

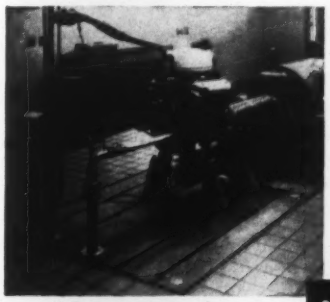
HYDRAULIC CONTROLLED REVERSING CLUTCH with TORQUE CONVERTER

Incorporate FUNK'S REVERS-O-MATIC in your moving equipment for maximum efficiency. Speed and direction of travel—forward and reverse or lift and lower—can be easily controlled with ONE LEVER or foot pedals. Converter eliminates shock and multiplies engine torque more than 200% to broaden the h.p. range.

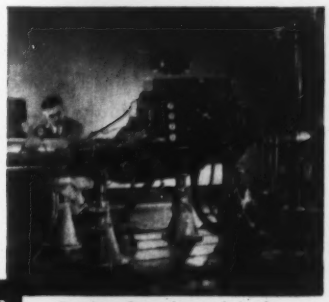
Our Standard Flange System affords unlimited combinations of FUNK MODULAR POWER UNITS. Let FUNK Engineers make specific recommendations.

FUNK AIRCRAFT CO

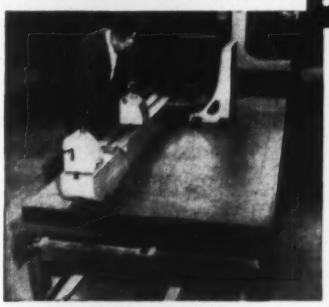
P.O. Box 577-E
Coffeyville, Kansas



* Dynamometer bases



Engine Stands and Jacks



Surface plates

Base plates

*Quality Control Starts Here**

. . . and from Lake Shore you have the opportunity to select from a complete line of standard plates and stands, or submit your specifications for plates engineered to your exact requirements.

Lake Shore plates are standard equipment in auto manufacturers' testing and development centers. Their highly accurate surfaces—either planer finish, machine ground or hand scraped—offer a "true reference" for precision work. Only flaw-free Lakenite iron is used to insure lasting reliability.

Send for a copy of our base plate booklet which illustrates the complete line of Lake Shore bases, plates and stands.

Please send me a free copy of the Lake Shore base plate booklet.

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Title_____

Company_____

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City_____ Zone____ State_____

Lake Shore, Inc.

Lake Shore Engineering Division

IRON MOUNTAIN 9, MICHIGAN

NOW! Cash Standard-Sparton brings you the World's First

Packaged Remote Control System

regulates final control elements governing

- **PRESSURE**
- **FLOW**
- **SURGE**
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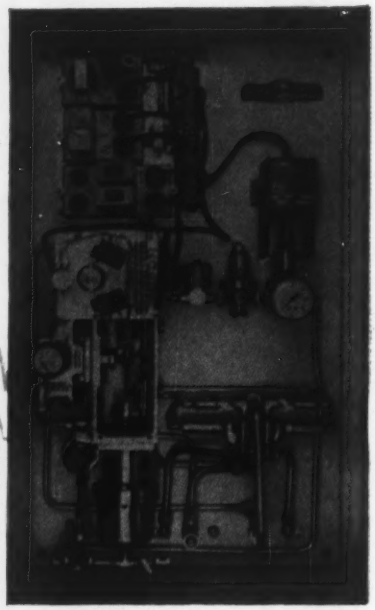
- **LIQUID LEVEL**
- **SPEED**

and other process variables

SUPERVISORY CONTROL UNIT

For remote location at distances of a few feet to many miles. Operates on telephone, telegraph, private lines or microwave.



Now—for the first time in a single package system—it is possible to control, from a distance of many miles if necessary, the positioning of cone, butterfly, plug and ball valves; sliding stem valves; throttles, rheostats and other variable speed mechanisms; and similar final control elements.

The unique Series 300 Packaged Control System, developed by A. W. Cash Company and Sparton Corporation, reduces operating costs substantially through regulation of final control elements by one operator from one central point. As a result, the equipment pays for itself rapidly. It is recommended particularly for such applications as pipe lines, pumping stations, oil wells, storage tanks, power stations, municipal water distribution, petroleum and chemical processing and atomic energy processing.

For complete information on the remarkable new Cash Standard-Sparton Series 300 Packaged Control System, see the Cash Standard control specialist in your area, or write to Dept. C.

CASH **STANDARD**

A. W. Cash Co. and Its Subsidiary, Cash Standard Stacon Corp.
P. O. Box 551, Decatur, Ill.

Pressure, Hydraulic, Temperature, Process and Combustion Controls

Opportunities

positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display advertisements carried in single-column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

POSITIONS OPEN

Mechanical Engineers

Research

Our Research Division has an attractive position involving a variety of challenging assignments relating to our extensive theoretical and applied research program. This program is made up entirely of civilian projects.

Nuclear Power

To keep ahead of the field of power, we are actively engaged in nuclear power generation projects. Engineers with reactor experience are urged to investigate opportunities with our rapidly developing Nuclear Power Division.

For further details, write to:

M. C. Rohm
Employment Section
Allis-Chalmers Mfg. Co.
Box 512
Milwaukee 1, Wisconsin

MECHANICAL ENGINEER

Graduate mechanical engineer in power plant design work. Experience not required. Excellent opportunity with consulting engineering firm in the Middle West. Liberal benefit plans and good working conditions.

Send resume of education and experience with statement of salary requirements.

Address CA-5905, % "Mechanical Engineering."

POLYETHYLENE SALES

Spencer seeks a man with enthusiasm, drive, and a desire for future progress in plastics sales or technical assignment. Plastics processing experience and/or sales experience desirable but not necessary. Location would be east coast or mid-west. Excellent opportunity for future advancement exists in a rapid expanding organization where annual sales have reached $45 million. Please send resume of your experience to:

General Sales Manager—Plastics Division
SPENCER CHEMICAL COMPANY
610 Dwight Building, Kansas City, Missouri

POWER & BOILER HOUSE SUPERVISOR

2 years' actual experience in each department for the operation of stoker fired boilers, ammonia refrigeration, D. C. generation, and plant utility supervision. College graduate—Salary open—Eastern Plant.

Address CA-6348
% "Mechanical Engineering."

Multi-plant manufacturer of precision mechanical springs and spring steel is opening a Central Research Laboratory in Central Connecticut. Need experienced stress analyst for work in design of spring structures to be used at high stress. Knowledge of applied mechanics and mechanical metallurgy necessary. Work is not currently concerned with laboratory measurement of stresses, but correlation of calculated stresses with service performance and theoretical background.

Address CA-6351, % "Mechanical Engineering."

SALES ENGINEER
DESIGN ENGINEER

Mechanical Engineers for either design or sales may find an opportunity with us, either designing or selling coal valves, coal scales and related items. Several new products will make the work interesting and create opportunities.

Sales engineer preferably should have a knowledge of coal fired steam boiler operation. Design engineer preferably should have experience with machine tool design, gear reducer design or design of similar items.

We are looking principally for trainees but we expect to hire one or two older men. If you would like to work for a small, active company where you know everybody—this is the position for you!

Write to: Daniel A. Hill, Stock Equipment Company, 745 Hanna Bldg., Cleveland 15, Ohio

ENGINEERS & SCIENTISTS INTERESTED IN

FLIGHT PROPULSION LABORATORY of GENERAL ELECTRIC

CINCINNATI 15, OHIO

At the level of investigation in progress at the Flight Propulsion Laboratory, so many technical disciplines merge and overlap, that engineering management here *can* and *will*

RE-DESIGN JOB SPECIFICATIONS TO UTILIZE YOUR TECHNICAL BACKGROUND TO THE FULL
...where your experience is substantial.

Opportunities now exist for highly qualified people to work with the Laboratory on advanced concepts and engineering principles applicable to jet and rocket propulsion systems that are planned to operate up to Mach 5 and beyond. FPL is interested in you if you have had 3 to 5 years or more in the following areas:

ADVANCED APPLIED MECHANICS • COMBUSTION • MECHANICAL DESIGN & ANALYSIS • NUMERICAL ANALYSIS • DEVELOPMENT TESTS • METALLURGICAL THEORY & PROCESSING • AERO-THERMO ANALYSIS

(Also a number of positions for engineers and scientists with 1 to 3 years' experience.)

Write Mr. Mark Peters, Building 100 Department 40-MK Flight Propulsion Lab.

An "Aircraft Propulsion Data Book," pocket size, prepared by General Electric, will be sent you on request.

decide today...
join the rewarding
industry of tomorrow

ENGINEERS

NEW POSITIONS FROM BEGINNING TO SUPERVISORY LEVEL

Development
Equipment
Industrial
Mechanical Systems
Metallurgical
Operating/Training
Process
Production
Reactor Design
Shielding
Testing
Welding

Joining the staff of Combustion Engineering means the start of a new career. These are not merely jobs, but, opportunities to work on projects years ahead. Combustion Engineering is one of the world's largest companies in the production of steam generating equipment. Its Reactor Development Division in Windsor, Connecticut, midway between New York and Boston is complete with new buildings, equipment and advanced facilities, providing the finest working conditions. We are now developing and manufacturing a nuclear propulsion plant for naval application. Excellent residential areas vary from rural to urban. In addition to many employee benefits, the company finances an advanced degree program at the Hartford Graduate Center of Rensselaer Polytechnic Institute. Write or call us now.

Submit Resume to Frederic A. Wyatt

COMBUSTION ENGINEERING, INC.
REACTOR DEVELOPMENT DIVISION
WINDSOR, CONN.

I am interested in the following position

_____

Name _____
Address _____
City _____ **State** _____

MECHANICAL ENGINEERS

A challenging opportunity to create

A challenging future with a small growth company is offered the engineer who is interested in a career opportunity utilizing his training and technical know-how.

Responsible engineering positions exist in the machine design and development of xerographic equipment. Xerography, a process for forming and using electro static images, is widely used in the copying and duplicating field. It is being developed for fascinating applications in automatic data processing, photography, office equipment, engineering drawing systems and interesting military applications.

Opportunities are available at all levels. There are openings also in products improvement and engineering standards work. Assignments are largely of the electro-mechanical type with a variety of optical, lighting, and electrostatic problems.

Previous experience in the design of office equipment or photographic equipment (military or commercial) would be helpful.

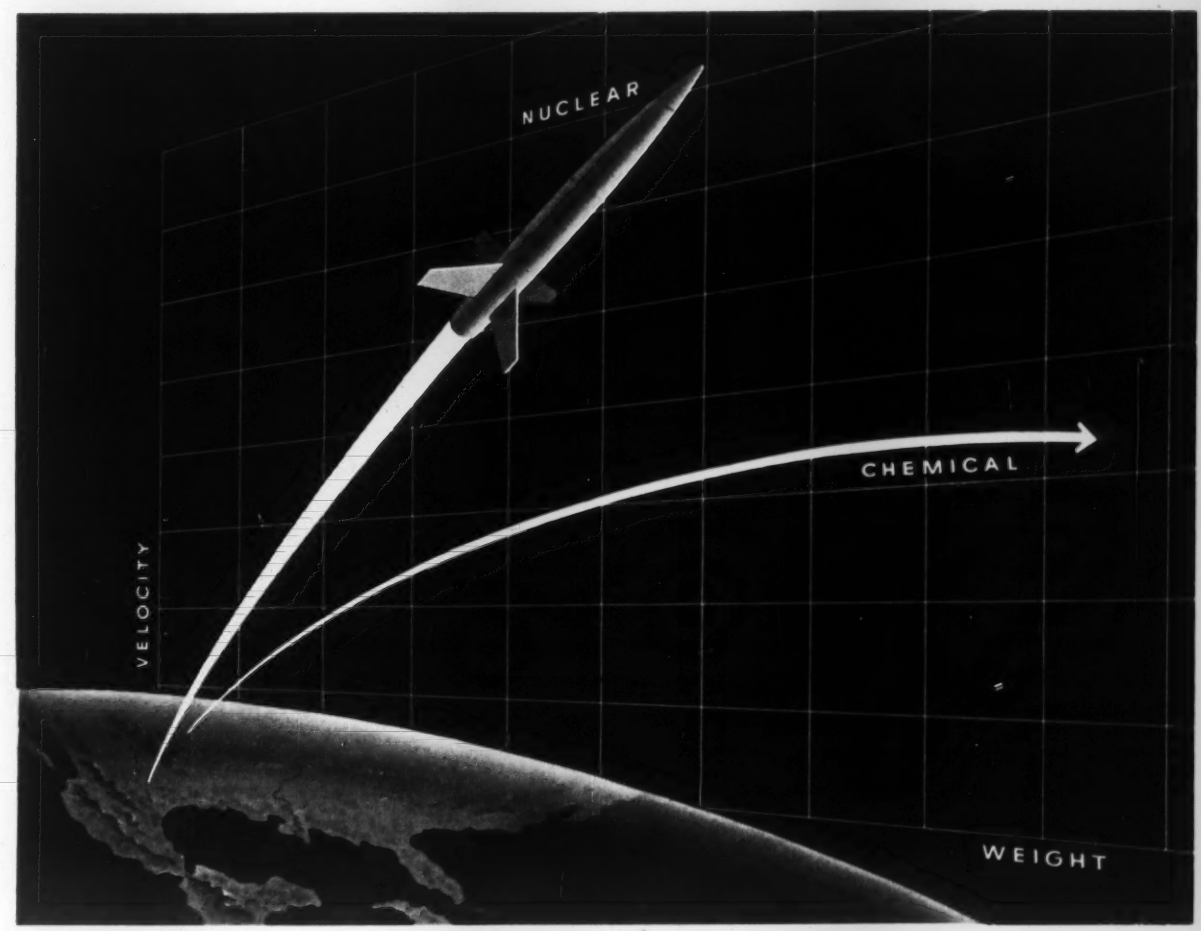
- **Comprehensive Employee Benefit Program**
- **Exceptional Tuition Refund Program**
- **Ideal living and recreational area**

HALOID

Kindly send resume and salary requirements to:

DAVID S. RAUB
Industrial Relations Division

THE HALOID COMPANY
ROCHESTER 3, NEW YORK



For a long range future . . .

Nuclear Rocket Propulsion at Los Alamos

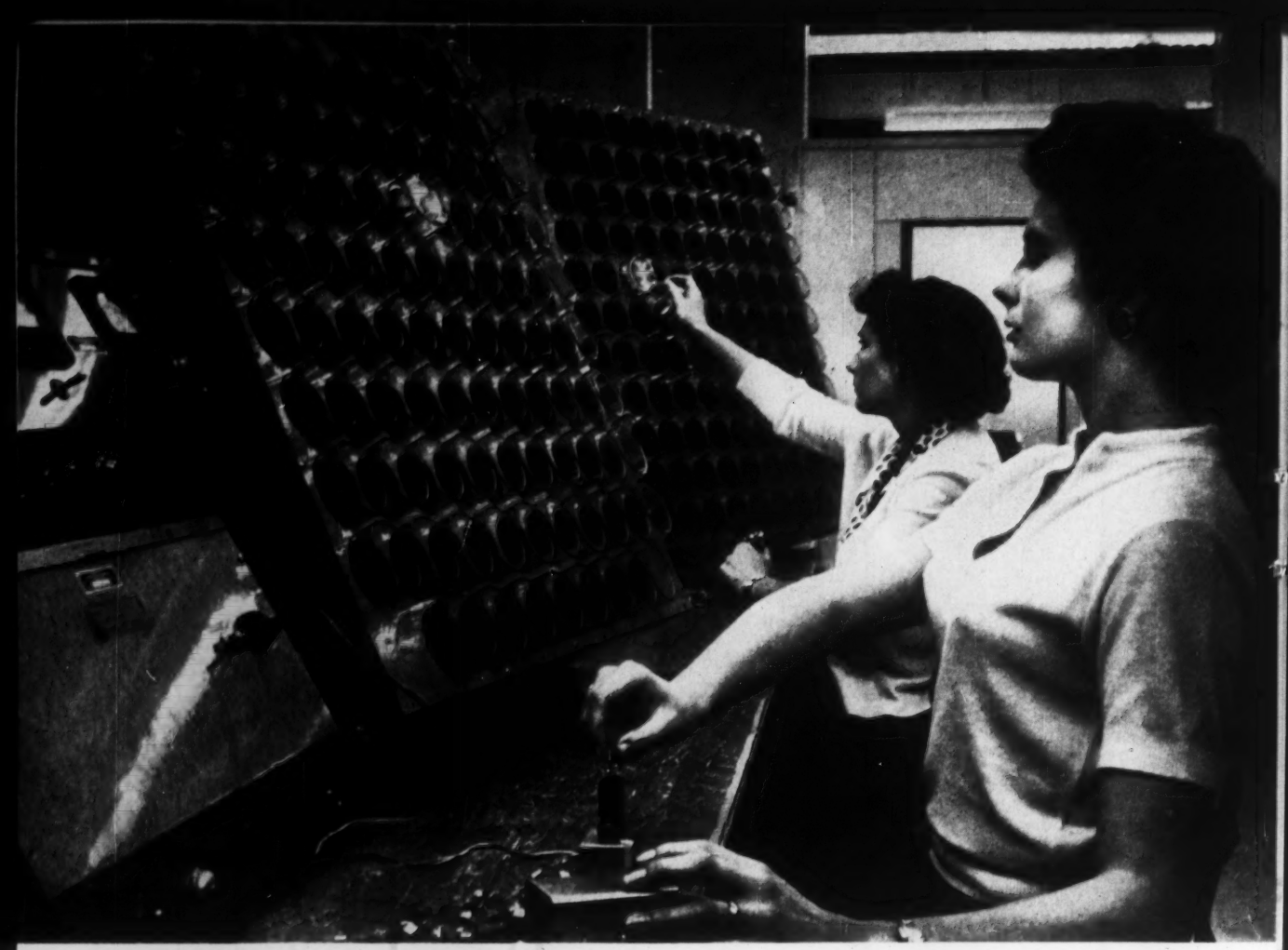
One of the most important programs at Los Alamos is research and development work aimed at utilizing nuclear energy for rocket propulsion. Investigations are being made in the fields of heat transfer, neutronics, fluid dynamics and rocket engine controls. Of special interest is the development of suitable materials for the very high temperatures involved.

The Laboratory is interested in inquiries from physicists, physical chemists, metallurgists and engineers who wish to engage in any phase of this well-rounded research program. We will send you information about the Laboratory and a color brochure describing this delightful northern New Mexico mountain community.

los alamos
scientific laboratory
OF THE UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

Write: Director of Personnel
Los Alamos Scientific Laboratory
Division 2307
Los Alamos, New Mexico

Los Alamos Scientific Laboratory is a non civil service operation of the University of California for the U. S. Atomic Energy Commission.



lighting a transistor's way home . . . automatically!

Homely articles like water glasses and light bulbs are used in this automated selector built by TI mechanization engineers. Now, non-technical TI-ers close a circuit with a transistor just off the production line; wait a second for the circuit to evaluate it; then pop the unit into the glass that lights up. This "matching" operation is another advance toward automation of semiconductor manufacture . . . to free technical personnel for other important duties . . . to help Texas Instruments produce more electronic components and apparatus at lower cost.

This special application is typical of the many special engineering opportunities now open at Texas Instruments . . . openings for industrial engineers, machine designers, automation engineers, and other specialists to fill a continuing need to develop the mechanics for making things that have never been made before. Eighty per cent of today's TI products are new to its production lines within the last 3 years.

You are invited to join one of the many expanding programs at 27-year-old Texas Instruments . . . where recognition of individual achievement has contributed to TI's twentyfold growth in the last ten years – to a current $70 million volume. Advanced personnel policies include company-sponsored educational assistance, profit sharing, insurance, and retirement programs.

Texas Instruments plants are within Dallas, yet away from downtown traffic . . within 5 minutes of fine residential areas, churches, and public and private schools. Your home will be within 15 minutes of year-around recreational, amusement and cultural activities.

SEMICONDUCTORS AND OTHER COMPONENTS – Design engineering, industrial engineering, production coordination, product evaluation, mechanization for making transistors, diodes, rectifiers, resistors, panel instruments. Write W. C. Spaller.

ELECTRONICS AND ELECTROMECHANICAL APPARATUS – Radar, sonar, infrared, navigation, magnetics, telemetering, communications, computers, transformers. Write R. E. Houston.

RESEARCH – Ph.D. level for research: semiconductor materials and devices, ferromagnetics, infrared, high speed data reduction, etc. ADMINISTRATION – Engineers for: production, planning, purchasing, cost analysis, etc. Write W. D. Coursey.

keep an eye on TI

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

IMPORTANT DEVELOPMENTS AT JPL

Teamwork in Missile Development

The Jet Propulsion Laboratory provides a wide range of research and development activities. Projects include problems in the fields of Electronic, Mechanical, Aeronautical, Chemical and Metallurgical Engineering, Physics and Mathematics.

The fluid character of these activities provides a keen incentive to JPL engineers and scientists. These men are given wide latitude and unusual individual responsibility—at the same time working as a thoroughly integrated team on all aspects of entire missile systems rather than on certain highly specialized missile components.

Job Opportunities Now in These Fields . . .

SYSTEMS ANALYSIS • INERTIAL GUIDANCE • COMPUTER EQUIPMENT • INSTRUMENTATION • TELEMETERING • FLUID MECHANICS • HEAT TRANSFER • AERODYNAMICS • APPLIED PHYSICS • PROPELLANTS AND MATERIALS RESEARCH

U. S. CITIZENSHIP REQUIRED

jpl

JET PROPULSION LABORATORY

A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA • CALIFORNIA

MECHANICAL ENGINEERS

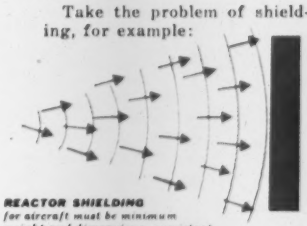
1 to 5 years' experience

interested in nucleonics:

CREATIVE M.E.s PUSHED TO LIMIT OF THEIR INGENUITY BY COMPLEXITIES OF AIRBORNE REACTOR DESIGN

Development of nuclear power systems for aircraft at General Electric requires peak M.E. skill, effort, and ingenuity . . . in such diverse areas as thermodynamics, stress and weight analysis, shield design, remote handling, heat transfer, air cycle analysis, turbojet applications, power plant components, reactor design and structures, airframe and structures, fluid flow . . .

Take the problem of shielding, for example:



REACTOR SHIELDING *for aircraft must be minimum weight and dimensions, consistent with adequate free flow area, and such conditions as compound reflection.*

Diverse Opportunities are now open for M.E.'s to work on equally complex problems in many areas of reactor design at the G-E Aircraft Nuclear Propulsion Department.

Is Nuclear Experience Necessary? No — not for a majority of current openings. In-plant courses and a Master's Degree Program, on full tuition refund basis, provide essential nuclear theory and technology. A FEW POSITIONS REQUIRE A SPECIALIST'S KNOWLEDGE OF NUCLEONICS.

Publication of technical papers is encouraged.

Location? Cincinnati, Ohio, known both as an engineering center and a fine place to live. Excellent housing available. (A few positions in Idaho Falls, Idaho.)

Please write in confidence to Mr. J. R. Rosselot. You will receive a prompt reply, and a copy of "Aircraft Nuclear Propulsion" by Dr. M. C. Leverett, Manager ANP Development Laboratory.

Aircraft Nuclear Propulsion Dept.

GENERAL ELECTRIC

P.O. Box 132, Cincinnati 15, Ohio

This is AC ...

. . . and the electronics business, including electro-mechanical devices of the most complex nature . . . from Inertial Guidance Systems for supersonic missiles to Afterburner Controls for jet engines.

This is GENERAL MOTORS...

. . . and all that the name implies—a solid, sound company with a policy of decentralization that offers greater opportunities for the growth of individuals within the organization.

This may be for you...

If you are a graduate engineer with an electrical, mechanical or electronic background (and 3 to 10 years experience), there is a spot for you at AC.

AC is now developing and producing Inertial Guidance Systems, Gyroscopes, Gyro-Accelerometers, Afterburner Fuel Controls, Speed Sensitive Switches, Speed Sensors, Three-way Selector Valves, Emergency Fuel Controls, Bombing Navigational Computers, Gun-Bomb-Rocket Sights, Manifold Air Pressure Regulators, and Torquemeters.

Opportunities now exist for you to work on any one of these projects, with some of the leading men in each of these fields.

If you feel AC may be the place for you, write or phone Mr. Cecil E. Sundeen, Supervisor of Technical Employment. AC . . . the Electronics Division of General Motors, 1925 E. Kenilworth, Milwaukee 1, Wisconsin.

AC THE ELECTRONICS DIVISION OF GENERAL MOTORS

IN ENGINEERING, THE BEST OPPORTUNITIES ARE IN AVIATION

IN AVIATION, THE BEST OPPORTUNITIES ARE AT TEMCO

STRUCTURES ANALYSIS ENGINEERS

Interesting missile and airframe prime contracts have created Senior level positions in Structures Analysis. Assignments are in Structural Methods, Structural Loads, and Structural Analysis groups. Applicable degree and 3-5 years direct experience required.

DYNAMICS ENGINEERS

Senior Engineering openings as well as Supervisory positions are available for qualified Dynamic Analysis and Dynamic Methods Engineers. Included are assignments in such areas as Theoretical Flutter Analysis, Supersonic Oscillating Aerodynamic Theory, Vibration Theory and Thermal Effects of Structures.

ELECTRONICS DESIGN ENGINEERS

Missile and aircraft prime contracts require extensive expansion of our electronics systems design and analysis sections. Experience preferred in transistor applications, pulse and video circuits, servomechanisms, general circuit design, guidance and radar systems analysis, audio circuits, electro-optical tranducers, microwave components design, radome design and antenna design.

EXPERIMENTAL LABORATORY ENGINEERS

High-temperature structures, environmental, servo, hydraulics, and instrumentation groups are but a few of the laboratory areas offering interesting and rewarding assignments on both missile and airframe prime programs. Senior Engineers and Engineer positions open.

TEMCO

AIRCRAFT CORPORATION *Dallas, Texas*

MR. JOE RUSSELL, Engineering Personnel
Dep't 170-C, Room 10, Temco Aircraft Corp.,
Box 6191, Dallas, Texas

Please send me complete details of the Temco story of unusual opportunities for creative engineers. I am especially interested in

NAME

ADDRESS

CITY STATE

DU PONT NOW OFFERS CAREER POSITIONS OF CHALLENGE AND RESPONSIBILITY IN SPECIALIZED AREAS OF MECHANICAL ENGINEERING

The Engineering Service Division of du Pont's Engineering Department provides consulting service and technical assistance to production, maintenance, design, research, and construction groups within the Company. The Division's objectives are to assist other company units in improving plant efficiency and product quality, in reducing investment and operating costs, and in increasing capacity.

These openings are immediately available for experienced graduate engineers to provide consulting service to operating plants in the following specialized mechanical engineering fields.

APPLIED MECHANICS Qualifications include 5 or more years' experience in machine design, teaching or machine development involving the study and testing of structures, and pressure vessels. Practical knowledge of and experience in vibration, dynamic effects, and specification of engineering materials is desirable. Successful applicant will provide consulting service to design groups, plants, and laboratories on vibration problems and on dynamic and static stress analysis of machine components and chemical plant equipment.

WATER The desirable qualifications include a comprehensive knowledge of water conditioning for industrial plants. Practical experience with water procurement, with operation of facilities for treating water for boiler feed, process, and drinking purposes and with waterside boiler inspections is important. The successful applicant will provide engineering advice to those designing, constructing, and operating company plants on problems involved in the procurement and treatment of industrial water supplies.

POWER Position requires extensive practical power experience including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction or in thermal insulation of process piping and equipment is desirable. Duties include: making economic evaluations and involved heat balances for complicated power systems; assisting in specification of power equipment and in selection of new facilities; and determination of causes of equipment malfunctioning and development of recommendations for corrections.

MATERIALS HANDLING This position requires 3 to 10 years' experience with bulk or package handling systems and equipment. The successful applicant will be expected to have engineering knowledge of belt conveyors, bucket elevators, screw conveyors, storage bins, chutes, hoppers, and feeders. Familiarity with pneumatic conveyors or mobile handling equipment is desirable. Duties include providing consultation on existing equipment, selection of new equipment, making cost studies, and development and execution of major materials handling engineering programs.

NEW YORK CITY INTERVIEWS

Sun-Mon-Tues-Wed
December 1-2-3-4
For an appointment, please call
Mr. K. S. Marlin, Jr.
PEnnsylvania 6-5877

CHICAGO INTERVIEWS

Sun-Mon-Tues-Wed
December 8-9-10-11
For an appointment, please call
Mr. K. S. Marlin, Jr.
WAbash 2-7992

or you may send complete resume, including details of education and experience, to:

Mr. K. S. Marlin, Jr., Engineering Department

E. I. du Pont de Nemours & Co., Inc.

Wilmington 98, Delaware

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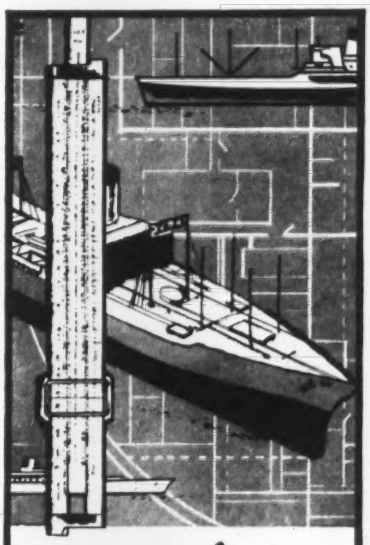
REG. U.S. PAT. OFF.

Better Things for Better Living
...through Chemistry



Immediate Openings

ON THE GULF COAST FOR

Engineers

THE INGALLS SHIPBUILDING CORPORATION, operating one of the largest shipyards in America on the Gulf Coast, offers immediate openings . . . promising futures with opportunities unlimited to the engineers, draftsmen and ship estimators who take part in INGALLS' new and dynamic naval, merchant ship and nuclear power development program.

If you are ready to meet a new challenge . . . to put your professional skills to full use . . . to live in a pleasant climate where traditions are rich and recreational facilities are at their best, we invite you to write to us about yourself. Your letter will be kept in strict confidence and answered promptly.

Address inquiries to
C. R. SCHAEFFNER, Chief Engineer;
Section 3A.

THE INGALLS SHIPBUILDING CORPORATION
Pascagoula, Mississippi

The **GENERAL** *Idea*

ON ENGINEERING CAREERS

GENERAL SYSTEM

Your job: find the one in 60 million

Direct distance dialing is the telephone industry's term for the comparatively recent introduction of dialing your long distance calls direct, instead of placing them through an operator.

Many electro-mechanical engineers at General Telephone Laboratories are working on the intricate and fascinating problems that continually arise in this particular phase of telephony.

To get an idea of the complexity of these projects, try to picture the telephone network of this country as a single, integrated machine consisting of about 60 million telephones. Then consider the task of connecting any one of these telephones to any other simply by dialing from ten to thirteen digits, instead of the conventional seven digits for local calls.

Remember that the connection must be made as quickly as it is in dialing your next door neighbor — and, of course, with the unfailing accuracy the public takes for granted in their dial telephone. Now you begin to comprehend the complex circuitry and high-speed switching that are the province of the telephone engineer.

Although direct distance dialing is a reality of some years standing in many parts of the country, not all the problems have been threshed out by a long shot. New detection methods are being investigated. Systems that work faster and take less space are the constant goal. And, as with every innovation in telephony, the problem of converting existing systems to handle the latest miracle is the telephone engineer's never-ending challenge.

The dial — automation's granddaddy

While the telephone industry did not invent the term automation, it did invent most of the processes and products that have made automation possible.

Filming high-speed rotary switches to study operations in slow motion.

For instance, the invention of the dial telephone by Automatic Electric engineers (that was 1892, believe it or not) led directly to automated assembly lines, automatic pin spotters, digital computers . . . you name it.

Automatic Electric is one of our affiliated manufacturing companies in the General Telephone System. For generations it has been a leading source of control components for industry as well as the principal equipment manufacturer for independent (non-Bell) telephone companies. And General Telephone Laboratories provide R&D support for the entire sphere of Automatic Electric's widely diversified manufacturing operations and for all of the other manufacturing and telephone operating companies in the General Telephone System.

You're invited . . .

The tremendous growth in the communications industry specifically and in the application of automation principles in general have created many stimulating new engineering opportunities here at General Telephone Laboratories. We're interested in you if you are qualified for important research and development work in electronics, electrical, electromechanical or mechanical engineering, or physics.

We can be much more specific about your particular career destinations if you will write directly to Mr. Robert Wopat, president, General Telephone Laboratories, Northlake, Illinois.

GENERAL TELEPHONE LABORATORIES
INCORPORATED
NORTHLAKE, ILLINOIS
A member of the General Telephone System—One of America's great communications systems

SALES ENGINEERS

Recent Engineering graduates, preferably M.E., for approximately one year inside sales training prior to assignment to a territory. Send complete resume to Personnel Department.

EDWARD VALVES, INC.
Subsidiary of Rockwell Manufacturing Company
1200 West 145th Street
East Chicago, Indiana

Product Development Engineers

Progressive manufacturer of pumping, water softening and agricultural spraying equipment has openings in its Product Development Division. Excellent opportunity for men in 25–35 age group to grow with an expanding and diversified program. Located in pleasant town of 16,000 northeastern Ohio. Experience in hydraulic or farm equipment with manufacturing background desirable. Must be capable of following project thru design, model building, testing and production release. Excellent drafting, model shop and testing facilities are part of division setup.

Liberal benefits program including insurance coverage, retirement and vacation policy.

All inquiries will be considered promptly and in strict confidence.

Please submit resume of personal data, education, experience and earnings in your reply to:

Mr. Frank Rucker
Personnel Manager
F. E. Myers & Bro. Co.
Ashland, Ohio

VALVE AND NUCLEAR ENGINEERS

Aggressive Research and Development activities have made Edward Valves, Inc., a leader in the steel valve industry.
We have expanded our Research facilities to maintain this position.
Openings are for Engineers (mechanical, stress, flow, materials, metallurgists) interested in design and development of valves for high pressure, high temperature service and nuclear power applications. Replies are confidential.

EDWARD VALVES, Inc.
Subsidiary of the Rockwell Manufacturing Company
1200 West 145th Street, East Chicago, Indiana
Mr. E. A. Loeser, Engineering Personnel

☆ ENGINEERS
☆ DRAFTSMEN
☆ MECHANICAL
☆ ELECTRICAL

Challenging opportunities in rapidly expanding power department of well established firm for men with experience in the design of

Steam Turbines Generators
Gas Turbines Insulation

Address CA-6354, care of "Mechanical Engineering," giving resume of educational background and working experience.

SEE CHEMSTRAND'S AD ON PAGE 81 OF THIS MAGAZINE

Positions available for

ENGINEERS
(Chemical, Mechanical, Metallurgical, Textile, Industrial, Instrument and Civil) and

CHEMISTS
(Organic, Physical, Analytical—Instrumental and Wet Method, Textile Chemists.)

Write to Technical Personnel Department

THE CHEMSTRAND CORPORATION
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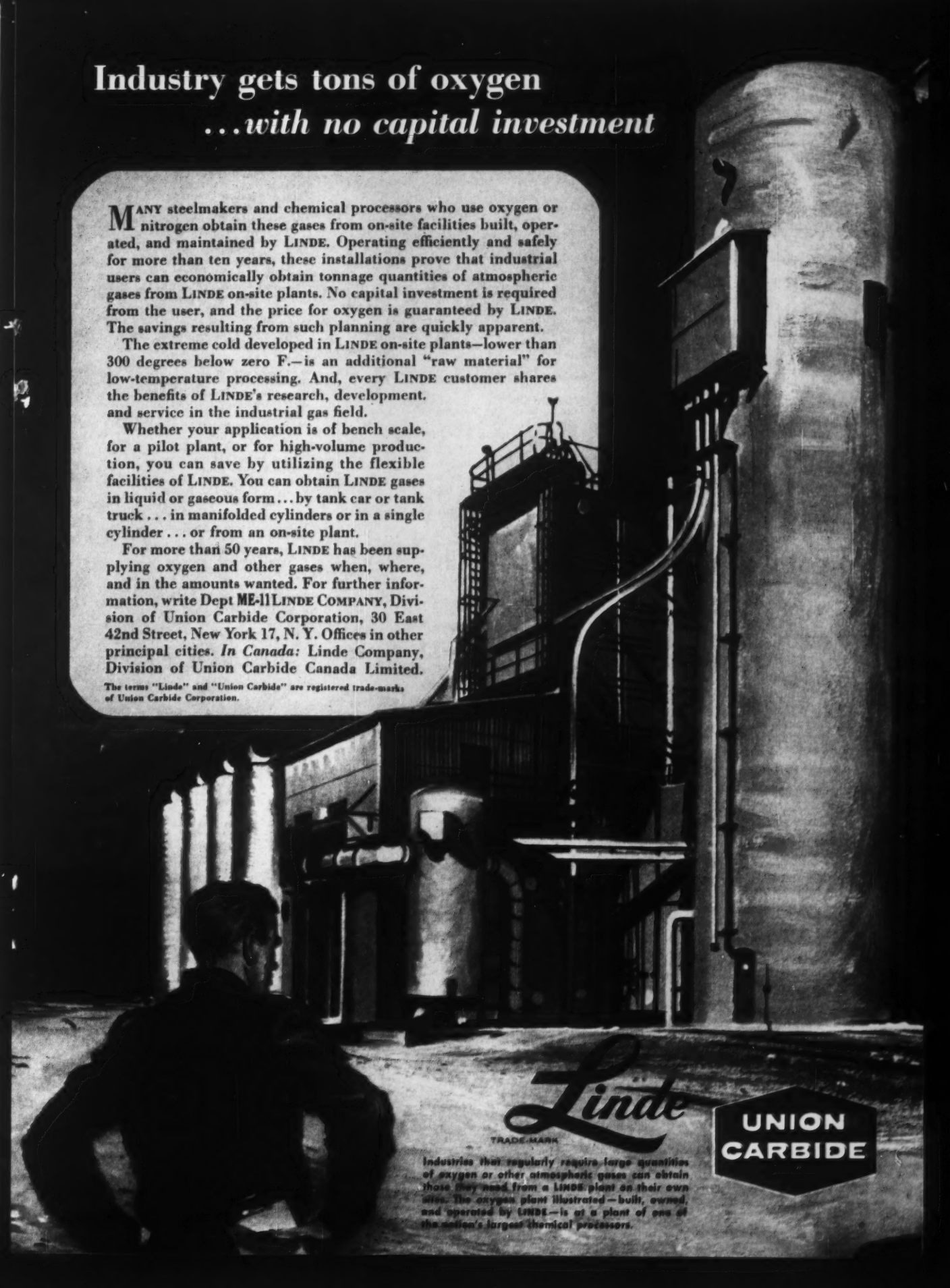

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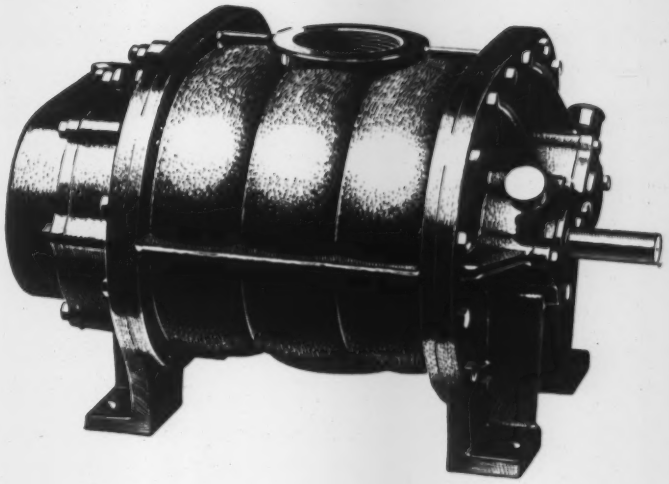

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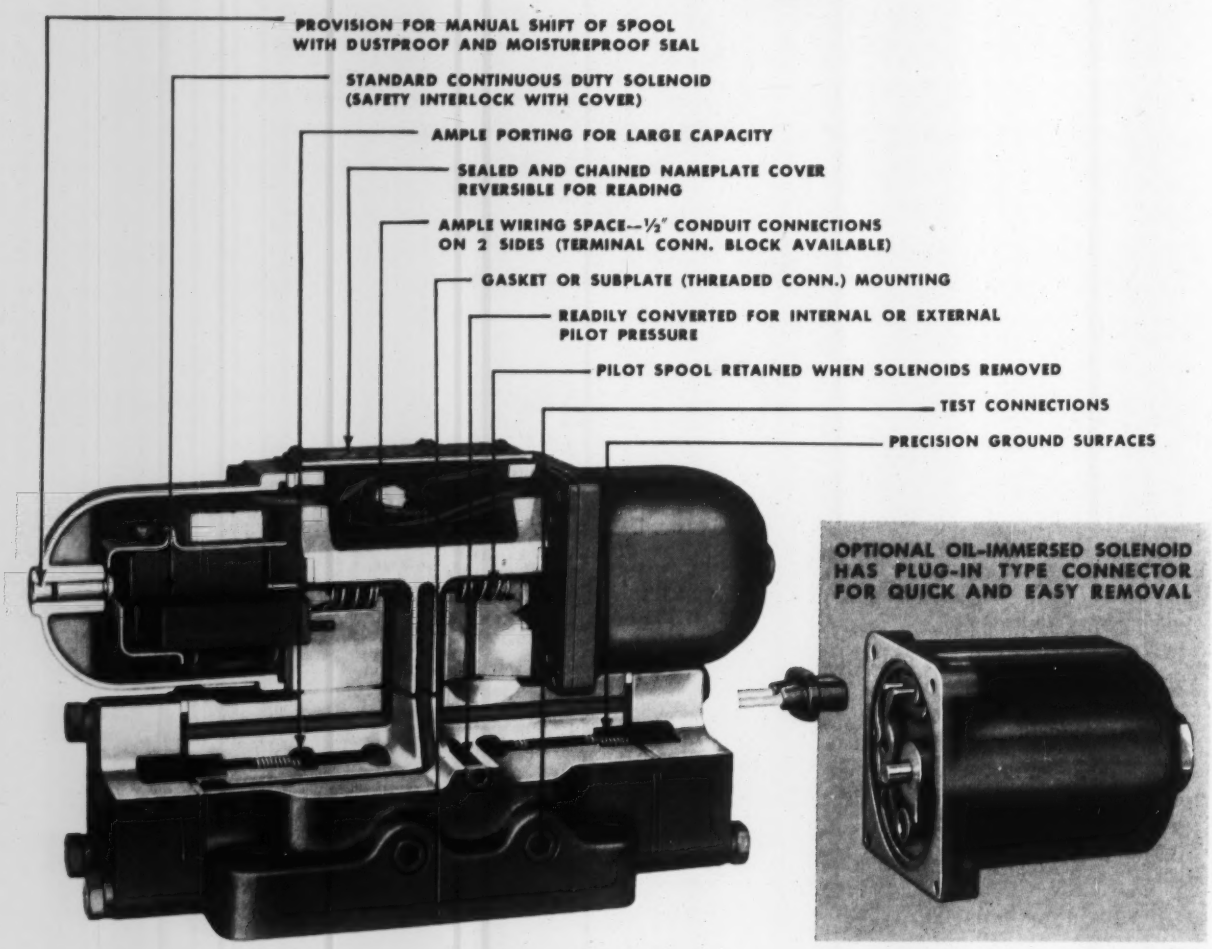
PROVISION FOR MANUAL SHIFT OF SPOOL WITH DUSTPROOF AND MOISTUREPROOF SEAL
STANDARD CONTINUOUS DUTY SOLENOID (SAFETY INTERLOCK WITH COVER)
AMPLE PORTING FOR LARGE CAPACITY
SEALED AND CHAINED NAMEPLATE COVER REVERSIBLE FOR READING
AMPLE WIRING SPACE—½" CONDUIT CONNECTIONS ON 2 SIDES (TERMINAL CONN. BLOCK AVAILABLE)
GASKET OR SUBPLATE (THREADED CONN.) MOUNTING
READILY CONVERTED FOR INTERNAL OR EXTERNAL PILOT PRESSURE
PILOT SPOOL RETAINED WHEN SOLENOIDS REMOVED
TEST CONNECTIONS
PRECISION GROUND SURFACES
OPTIONAL OIL-IMMERSED SOLENOID HAS PLUG-IN TYPE CONNECTOR FOR QUICK AND EASY REMOVAL

7897

REDUCED DOWN-TIME
LONGER SOLENOID LIFE
LESS MAINTENANCE
EASIER INSTALLATION

Vickers hydraulic 2- and 4-way valves provide the optimum in directional control. They are compact, versatile, and are designed for heavy duty, continuous and rapid cycling operation on all types of industrial machinery. More than a decade of application experience and years of research and development back all the valves' features.

Seven spool types satisfy a wide variety of circuit needs and operate at pressures to 3000 psi. Optional oil-immersed solenoids operate cooler, increasing service life 20 to 30 times.

Installation is simplified with ease of wiring and a minimum of piping. The valves are available for gasket or sub-plate mounting. Mounting position is unrestricted except in "no-spring" models. The optional oil-immersed solenoid has a plug-in type connector and is available in all standard voltages. Field modification of existing units can be made to incorporate heavy-duty, oil-immersed solenoids.

The valves conform to JIC Standards and are available in ⅛" and ¼" direct solenoid operated models . . . ¾", 1¼", 2", and 3" solenoid controlled pilot operated models. These valves cover the flow range from 1.25 gpm to 320 gpm.

For further information, write for Installation Drawing I-182412.

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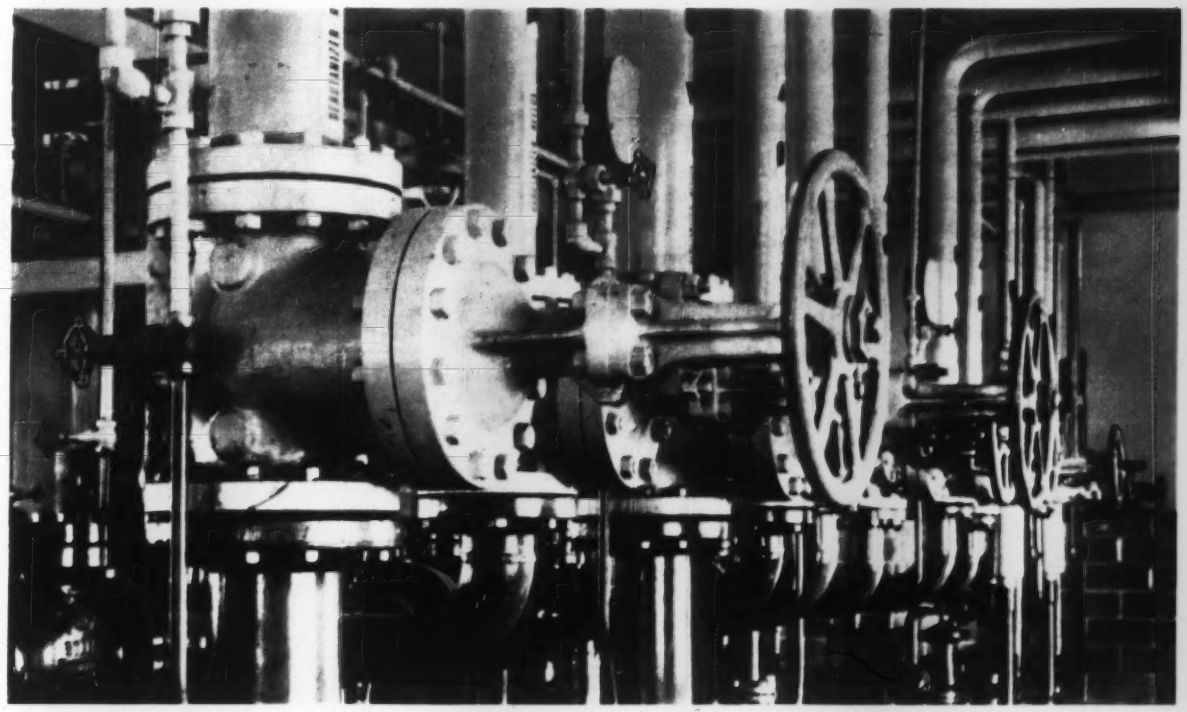
Don't Hedge on Quality When You Buy Steel Valves...

Maintenance costs can gobble up your savings in a few months!



LUNKENHEIMER QUALITY is no longer a luxury—it's your vitally needed insurance against today's sky-high maintenance expense. Labor rates are going still higher . . . "downtime" costs are multiplying . . . repair charges are rocketing up—with no relief in sight. Today, it pays to buy the *best valves you can get,* with no hedging on quality. Your purchase of Lunkenheimer Steel Valves is an investment that pays worthwhile dividends in maintenance savings . . . year after trouble-free year. The Lunkenheimer Company, Box 360, Annex Station, Cincinnati 14, Ohio.

The cost of a LUNKENHEIMER VALVE
Gets smaller...and smaller...and smaller...
with each passing year of dependable service

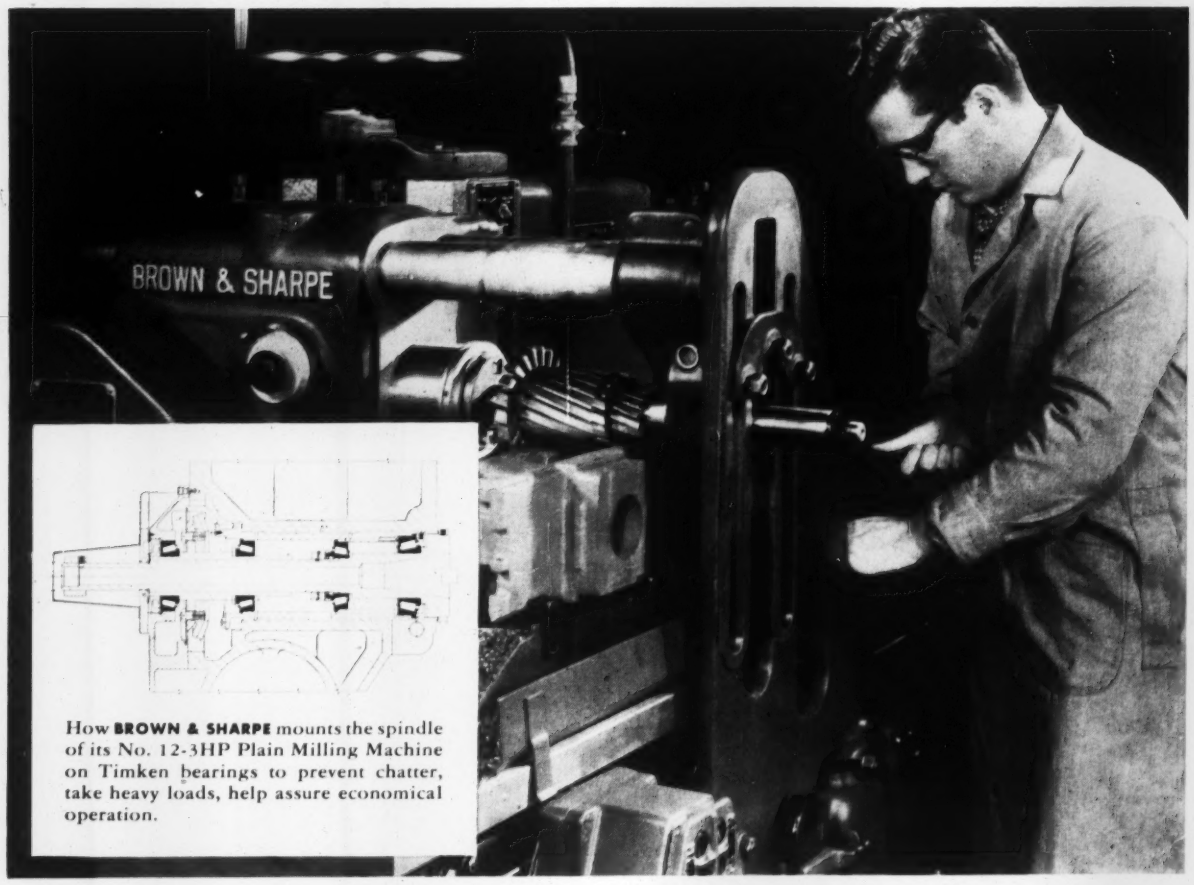
A check on the cost of maintaining your cast steel valves will prove this point.

STEEL • BRONZE • IRON • PVC

L-1056-2

LUNKENHEIMER QUALITY

LUNKENHEIMER®
THE ONE *Great* NAME IN VALVES



How **BROWN & SHARPE** mounts the spindle of its No. 12-3HP Plain Milling Machine on Timken bearings to prevent chatter, take heavy loads, help assure economical operation.

Climb mills both ways . . . TIMKEN® bearings prevent chatter in heavy cutting

TO make heavy cuts without chatter, Brown & Sharpe mounts the spindle of its No. 12-3HP Plain Milling Machine on two Timken* tapered roller bearings. For smooth power transmission, they use four Timken bearings in the bevel gear drive to the spindle. And to take climb milling's pulsating loads, two Timken bearings are used in the feed screw drive. Result—production milling is fast and accurate. Here's why.

• SPINDLE RIGIDITY MAINTAINED

Timken bearings hold the spindle in positive alignment. Their tapered design lets them take *both* radial and thrust loads in any combination. And full line contact between rollers and races gives Timken bearings extra load-carrying capacity.

• HEAVY LOADS ABSORBED

Rollers and races on Timken bearings are case-carburized to have a hard, wear-resistant surface over a tough, shock-resistant core. They take heavy loads and come back for more.

• FRICTION VIRTUALLY ELIMINATED

Timken bearings are geometrically designed to have true rolling motion and are precision-made to live up to their design. Practically friction-free, they last longer and run smoother. And to assure complete quality control, we even make our own electric furnace fine alloy steel. No other American bearing maker does. So for your No. 1 bearing value, always specify bearings trade-marked "TIMKEN". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS ROLL THE LOAD

See the next Timken Televent hour, "The Innocent Years" over NBC-TV, Thursday night, November 21st.